STATION NOTE

No. 157
October 1962

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio R. D. Lane, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

BUYING PRACTICES AND MARKETS OF OHIO'S SAWMILLS 1955 - 1958

Stumpage purchases provided most of the timber used by Ohio sawmills from 1955 to 1958. Most of the stumpage purchases were on a lump-sum basis, but log scale was increasingly used to determine payment during the period. Lumber output of Ohio mills was utilized mainly by furniture and allied manufacturers, along with pallet, blocking, and crating firms.

The quantities of timber and the money involved indicate the importance of the sawmill industry to the State. In 1956, more than 500 of Ohio's mills were each producing more than a tenth of a million board feet of lumber annually.1/ In 1958, all sawmills in the State, taken together, were producing more than 201 million board feet of lumber. With planing mills included, they paid more than $5,500,000 in wages and salaries, and shipped products worth more than $21,000,000.2/

BUYING PRACTICES

During the study period mill operators purchased about 69 percent of the timber as stumpage. They bought the remainder as logs, delivered to the mill or stacked at the roadside. Those sawmills producing less than 1 million board feet annually bought nearly three-fourths of their timber as stumpage. These small mills tended to rely on stumpage more each year. On the other hand, large sawmills, those producing more than 1 million board feet each year, bought less than two-thirds of their timber as stumpage.

Small mills buy more of their timber as stumpage than as logs delivered to the mill for several reasons: (1) Limited log storage space at the mill makes it desirable to defer cutting until logs are needed, (2) many sellers prefer to sell stumpage, (3) the same crew can be used for both logging and milling, and (4) many small sawmills operate sporadically and hence do not provide a steady market for log producers.

Nearly two-thirds of all stumpage purchased by Ohio mills is paid for on a lump-sum basis. That is, the buyer pays a given sum of money for all trees found on a tract of land that meet certain

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1/ McCauley, Orris D., and Quigley, Kenneth L. Markets for Ohio timber. U.S. Dept. Agr., Forest Serv., Cent. States Forest Expt. Sta. Misc. Release 14, 53 pp., illus. 1957.

2/ Bureau of the Census, U.S. Department of Commerce. 1958 Census of manufacturers. Bul. MC58(2)-24A, tables 2 and 6C.

specifications. Most of the remaining stumpage is purchased on a log-scale basis by the Doyle rule. Small quantities are bought by the mill or lumber scale. By this method, the buyer pays for the actual lumber sawn out of trees purchased, based on the sawyer's volume tally.

By lump-sum payment, the buyer and seller avoid bargaining over the volume and grade of individual logs. However, the trend among large mills is to use log scale more and more to pay for stumpage. Although they bought 29 percent of their standing timber by log scale in 1956, the amount increased to 43 percent in 1958. On the other hand, small sawmills increased the volume that they bought by lump-sum payment (from 56 to 68 percent).

The Doyle rule is used by 97 percent of the sawmills making log-scale payments. The actual lumber volume sawn from small logs is usually greater than the Doyle log rule indicates. Thus the mill operators who are sawing small logs purchased by the Doyle rule do not need to vary log prices with diameter to obtain the margin needed to cover the increased sawing costs. The other rules sometimes used by Ohio sawmills are the Scribner Decimal C, the Doyle-Scribner, and the International 1/4 inch.

During the period, 1955-1958, most Ohio sawmills purchasing stumpage or logs specified logs 12 inches or more in diameter on the small end and at least 8 feet long. However, minimum diameters specified ranged from 6 to 18 inches and minimum lengths from 6 to 16 feet. Sawmills primarily producing factory grade lumber specified diameter larger than the average minimum for the industry. On the other hand, mills producing mainly for pallet, blocking, and crating markets specified minimum diameter smaller than the average. Unlike minimum diameter, the minimum length specified did not depend on the kind of product manufactured.

PRODUCT SALES

Markets serving Ohio sawmills varied from year to year, but variations did not show any trend toward a particular market. Two markets--furniture, cabinet, trim, and novelty manufacturers and pallet, blocking, and crating manufacturers--purchased nearly two-thirds of the lumber produced by Ohio sawmills during the study period. Their nearness offers the advantage of reduced transportation costs to Ohio lumber producers. The remaining one-third was bought by lumber concentrators (19 percent), farmers (11 percent), and contractors and others (5 percent).

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No. 156
August 1962

STATION NOTE

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio R. D. Lane, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

METHOXYCHLOR: SAFE AND EFFECTIVE SUBSTITUTE FOR DDT IN CONTROLLING DUTCH ELM DISEASE

Dutch elm disease is one of the most devastating pests of shade trees in the United States. The only known method of reducing losses from this disease is by spraying healthy elms to prevent feeding by the bark beetle carrier and destroying the breeding sources of this insect.

Many cities have been following the current recommendations for protecting their elms as outlined in Agriculture Information Bulletin No. 193 published by the U.S. Department of Agriculture. This method, involving the use of DDT, has been successful in holding the losses from this disease to 1 percent or less where the spray was properly formulated and timed and adequately applied. But because DDT is somewhat toxic to birds and other wildlife, a less harmful insecticide is desired.

Among the many materials that have been evaluated for control of the Dutch elm disease, methoxychlor compared favorably with DDT in effectiveness and residual qualities and is one of the least toxic insecticides to birds and mammals. This material has two disadvantages.

One that showed up when the original studies were made 10 years ago was that it was injurious to leaf buds when applied at about the time buds were opening. (No injury occurred when the trees were dormant.) Since then, however, it is claimed that the formula has been changed to make the material less toxic to plants. The other disadvantage of methoxychlor is its cost: generally it is more expensive than DDT (2 to 4 times as much). Both these disadvantages can be at least partially counteracted by applying the spray during the dormant season and by using minimum concentrations of the active ingredients.

Studies conducted in cooperation with the Parks Department in Columbus, Ohio and with the National Capital Parks Service in Washington, D. C. show that 3, 6, 9, and 12 percent concentrations of methoxychlor were as effective as similar concentrations of DDT. The three higher concentrations of methoxychlor gave 98 percent control or better up to the time the studies were concluded (90 days in Washington, 150 days in Ohio). The 3 percent methoxychlor gave

94 percent control or better up to the time the work was concluded, while DDT gave 92 percent control at the end of 150 days. There is no reason to believe that such sprays would not last as long as 250 days as have hydraulically applied sprays in other studies.

The sprays were applied as emulsions with a high velocity mist blower at the rate of 1 to 3 gallons of spray per tree depending upon the tree size (25 to 50 feet high). All treatments were made in April before the leaves had emerged.

On the basis of this and other research it is safe to conclude that when coverage is comparable, methoxychlor is fully as effective as that of DDT. This means that spraying may be done at any time during the dormant season. Methoxychlor emulsified spray is especially recommended as a substitute for DDT for control of Dutch elm disease in areas where bird and other wildlife mortality is an obstacle to the use of DDT.

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STATION NOTE

No. 155
August 1962

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio R. D. Lane, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

NORTHERN SEED SOURCES BEST
FOR SHORTLEAF PINE PLANTINGS IN MISSOURI

Survival of the millions of shortleaf pine (*Pinus echinata* Mill.) seedlings planted annually in Missouri ranges from excellent to poor. Some losses may be attributed to drought, grazing, poor planting stock or technique, or perhaps to unsuitable sites. But other failures are difficult to explain and may be related to the seed source.

In a recent study, seed from widely scattered sources was used to produce 1-0 seedlings. When the seedlings were planted in a Missouri Ozark forest soil, survival varied greatly. Latitude of the seed source, however, was directly related to seedling survival.

This study is a part of the regional provenance studies sponsored by the Southern Forest Tree Improvement Committee.[1] Seed was collected in 1951 and 1955 from shortleaf pine trees in various parts of the species' natural range (table 1). The seed sources range from 31° to 40° north latitude, from Louisiana to New Jersey. The seedlings were grown in the Missouri Conservation Commission Nursery, Licking, Missouri, and planted in the springs of 1953 (a very dry year) and 1957 (a wet year) on the Sinkin Experimental Forest in Dent County, Missouri.

The planting sites are adjacent, moderately steep, upper southwest and northeast slopes of a narrow ridge. The soil is Clarksville stony loam. A natural 45-year-old oak-pine stand growing on the area was removed the winter before each planting. Merchantable trees were cut and all other trees were killed with 2,4,5-T applied in low frills.

By 1959 survival of the planted trees differed greatly. For the 1953 planting, survival among sources ranged from 24 to 70 percent; for the 1957 planting, it ranged from 45 to 84 percent. In both plantings most losses occurred during the first growing season. Subsequent mortality did not change survival relations among seed sources. Height growth was satisfactory and relatively uniform for each study regardless of seed source.

1/ Subcommittee on Geographic Source of Seed: Working plan for Cooperative Study of Geographic Southern Pine Seed, Southern Forest Experiment Station, 32 pp. 1952.

Table 1.--Shortleaf pine seedling survival and height in 1959 by seed source

PLANTED IN 1953

Seed source: State	County	Latitude (degrees north)	Survival	Height
			percent	feet
New Jersey	Burlington	40	70	13.5
Missouri	Dent	37	66	11.8
Tennessee	Morgan	36	60	13.0
Mississippi	Lafayette	34	53	12.4
Arkansas	Clark	34	53	13.0
Arkansas	Ashley	32	32	11.9
Louisiana	St. Helena Parish	31	24	12.0

PLANTED IN 1957

New Jersey	Burlington	40	76	2.9
Missouri	Dent	37	84	2.9
Tennessee	Anderson	36	75	3.2
Virginia	South Hampton	36	67	2.7
South Carolina	Union	35	65	3.2
Georgia	Webster	32	45	2.6
Louisiana	St. Helena Parish	31	58	3.5

More trees from cool-climate seed sources survived than from warm-climate sources. Trees from seed originating north of 36° latitude survived best. The best seed sources for this Ozark site were Missouri, Tennessee, and New Jersey; the poorest--south Arkansas, Louisiana, and Georgia.

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STATION NOTE

No. 154
July 1962

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio
R. D. Lane, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

REDUCE RED OAK BORER DAMAGE SILVICULTURALLY

The red oak borer (Romaleum rufulum (Hald.)) seriously damages hardwood trees (chiefly scarlet, black, and red oaks) in the Central States by boring into and through the wood, creating large, extensive galleries. We have found that proper timing of stand-improvement work can reduce both the population of the borer and damage to the residual stands of upland oak. Most borer larvae die if the host tree is poisoned at the right time.

The forester selecting trees to be killed in the improvement work need not look for special signs of borer attack. Trees selected for poisoning because of obvious low quality are trees likely to be heavily infested.

The red oak borer has a 2-year life cycle. The female deposits her eggs on the stem of trees 2 inches in diameter and larger although oviposition is most common on trees 4 to 10 inches in diameter.

The newly hatched larva bores directly from the egg capsule into the inner-bark phloem area where the insect spends the first year of its life forming a cave-shaped burrow about 2 by 5 inches in size. About August, beginning its second year of life, the larva extends its burrow into the wood, mining obliquely upward through the sapwood and then vertically upward in the heartwood for 6 to 10 inches. The pupal stage is reached in June and 2 to 4 weeks later the adult emerges from the entrance hole made previously by the larva. Adults emerge in the odd-numbered years in Kentucky and probably elsewhere in the Central States.

A recent study in Kentucky shows that survival of the red oak borer to adult emergence depends primarily on the stage of larval development at the time the tree is poisoned. Once the larva has begun or is nearly ready to begin its burrow into the sapwood, it is too late to kill the insect by killing the tree. Most larvae reach this burrowing stage of development in August.

In our study tree species represented were scarlet, black, and red oaks. They ranged from 5 inches to 12 inches in diameter at breast height. Trees were poisoned with 2,4,5-T in oil applied in a basal frill. At the time each tree was poisoned cages were placed over all fresh borer holes within 6 feet of the ground.

Few adult borers emerged from trees poisoned June 15 (table 1). No emergence would have been expected if trees had been poisoned 2 to 4 weeks earlier. The mid-June poisoning killed trees before larvae started into the wood. But larvae had penetrated the wood for some 3 to 4 inches before most trees poisoned in mid-July died. The mid-August treatment was obviously too late: more adult borers emerged from the poisoned trees than from the check trees. Differences were statistically significant (at the 5 percent level) only between the June and August treatments.

We can conclude then that a larva in a tree poisoned before June of even-numbered years will probably be killed. On June 1 the larva is nearly ready to enter the wood. Because it has a 2-year life cycle, the borer is vulnerable to control by tree poisoning 1 year out of every 2--from the peak adult emergence date, about July of the odd-numbered years, to June of even-numbered years.

Table 1.--Survival of borers after tree poisoning during the summer of 1960

Date poisoned	Active attacks on date of poisoning	Attacks from which adults emerged	Attacks with no emergence
	Number	Number	Percent
June 15	40	2	95
July 15	52	10	81
August 15	29	21	28

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STATION NOTE

No. 153
April 1962

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio R. D. Lane, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

COOPERAGE LOGS AND BOLTS - PRODUCTION AND CONSUMPTION IN THE CENTRAL STATES - 1960

Cooperage logs and bolts produced from Central States forests in 1960 amounted to more than 120 million board feet, a 33 percent increase over 1958 production. This high-quality timber, predominantly white oak, had an estimated value of $4,825,000 delivered at the mill.[1/] Small-woodland owners and loggers shared this income, while operators and workmen at 123 mills profited by processing these logs and bolts into cooperage stock.

Missouri Again Largest Producer.--Missouri in 1960 again supplied more than one-third of the cooperage logs and bolts, thus retaining its lead (table 1). Kentucky and Illinois, also prominent, each accounted for more than one-fifth of the 1960 production. All states increased production over that of 1958.

Oaks Predominate.--White oak made up about 83 percent of the more than 120 million board feet produced. Bur and post oaks composed 10 percent of production; these three species are utilized for tight cooperage. Species utilized for slack cooperage, elm, gum, sycamore, hackberry, cottonwood, and others, accounted for the remaining 7 percent.

Missouri Again Largest Consumer.--Mills in the Central States manufactured more than 123 million board feet of cooperage logs and bolts into rough staves and heading (table 2). Missouri consumed one-third of the total. Kentucky and Illinois accounted for approximately one-fourth and one-fifth of the total.

Interregional Shipments Increase.--Interregional shipments of stave logs and bolts totaled 4,193,000 board feet in 1960, an increase of more than 1 million board feet over 1958. Imports exceeded exports by 2,793,000 board feet. Imports from Wisconsin, West Virginia, Kansas, Tennessee, and other states amounted to 3,493,000 board feet. All of the Central States except Iowa imported cooperage timber. Exports, amounting to only 700,000 board feet, primarily from Iowa, were shipped to Wisconsin and Minnesota.

About This Canvass.--The 1960 canvass, the second biennial canvass of the cooperage industry, recorded the activity of 123 mills in the Central States (fig. 1). In 1958 only 83 mills reported. Much of the increase in production and consumption can be attributed to the increase in mills reporting.

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David W. Kaney, research forester
Central States Forest Experiment Station

1/ Calculated on basis of $40 per 1,000 board feet, International 1/4-inch rule.

Table 1.--Production of cooperage logs and bolts in Central States by source and destination--1960
(In 1,000 board feet, International 1/4-inch rule)1/

Destination	Source						
	Ohio	Indiana	Illinois	Kentucky	Missouri	Iowa	Total
Ohio	12,728	858	--	206	--	--	
Indiana	172	5,770	322	462	--	--	
Illinois	--	220	25,390	--	29	27	
Kentucky	698	84	777	27,582	--	--	
Missouri	--	--	--	--	40,107	84	
Iowa	--	--	928	--	743	2,745	
Exports	--	--	2	--	--	698	
Total	13,598	6,932	27,419	28,250	40,879	3,554	120,632
Percent	11.3	5.8	22.7	23.4	33.9	2.9	100.0
Percent change from 1958	+58.5	+107.8	+10.9	+26.9	+32.7	+137.4	+32.2

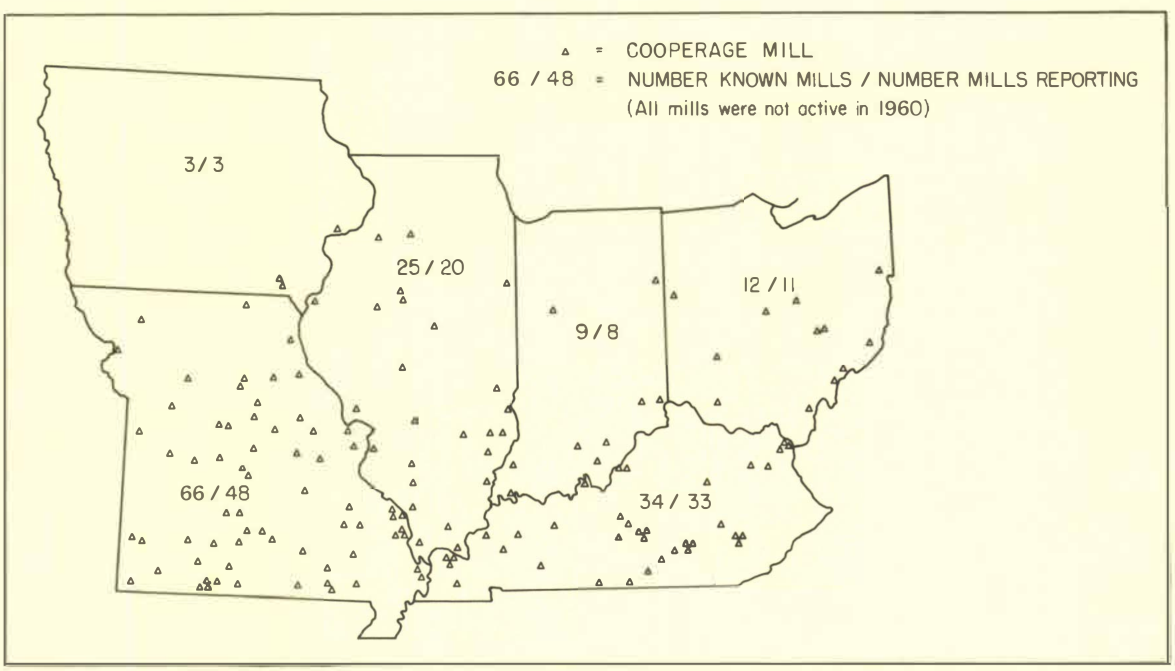
1/ 1,000 board feet equals approximately 100 chord feet.

Table 2.--Consumption of cooperage logs and bolts in Central States by source and destination--1960
(In 1,000 board feet, International 1/4-inch rule)1/

Source	Destination						
	Ohio	Indiana	Illinois	Kentucky	Missouri	Iowa	Total
Ohio	12,728	172	--	698	--	--	
Indiana	858	5,770	220	84	--	--	
Illinois	--	322	25,390	777	--	928	
Kentucky	206	462	--	27,582	--	--	
Missouri	--	--	29	--	40,107	743	
Iowa	--	--	27	--	84	2,745	
Imports	943	136	1,233	618	563	--	
Total	14,735	6,862	26,899	29,759	40,754	4,416	123,425
Percent	11.9	5.6	21.8	24.1	33.0	3.6	100.0

1/ 1,000 board feet equals approximately 100 chord feet.

Figure 1.--Cooperage mills in the Central States.



No. 152
December 1961

STATION NOTE

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio R. D. Lane, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

SPRAYING, SEEDING, AND FERTILIZING INCREASE FORAGE ON OZARK FOREST RANGES

Spraying with herbicides, seeding with introduced or native forage species, and applying commercial fertilizer greatly increased forage production the first year after treatment on Ozark forest ranges in southwest Missouri. On a forest range where past overgrazing had greatly reduced the desirable native forage species, just spraying the unwanted hardwoods with 2,4,5-T was not enough. Seeding some adapted forage species and applying commercial fertilizer were necessary to obtain large early increases in forage production.

Several forest sites ranging from good to poor were aerial sprayed in July 1959 with 2,4,5-T at a rate of 2 pounds acid equivalent per acre in 4.5 gallons of fuel oil. Three seeding treatments were applied on these sprayed areas: (1) A tame grass-legume mixture, K-31 fescue (Festuca arundinacea Schreb) at 10 pounds per acre with Korean and sericea lespedeza (Lespedeza stipulacea Maxim.) and (L. cuneata Dum.-Cours.-G.-Don.), each at 2 pounds per acre; (2) a native grass mixture, little bluestem (Andropogon scoparius Michx.) at 7 pounds per acre with big bluestem (A. gerardi Vitm.), Indiangrass (Sorghastrum nutans L.-Nash), switchgrass (Panicum virgatum L.), and sideoats grama (Bouteloua curtipendula Michx.-Torr.), each at 3 1/2 pounds per acre; and (3) no seeding. The effect of 320 pounds per acre of 8-24-8 fertilizer was compared with no fertilizer on all seeding treatments. The fescue was seeded in September 1959, the native species in February and March 1960, and the lespedeza in March 1960. The fertilizer was applied in March 1960.

The herbaceous vegetation before treatment on these forest sites consisted mostly of poor forage species such as poverty oat grass (Danthonia spicata L.-Beauv.), sedges (Carex spp.), and panic grasses (Panicum spp.) with only a scattered remnant of more desirable forage species such as little bluestem. The overstory was mostly post oak (Quercus stellata Wangenh.) and blackjack oak (Q. marilandica Muenchh.) with lesser amounts of white oak (Q. alba L.) and black oak (Q. velutina Lam.). The stony, cherty soil (Clarksville stony loam) is low in fertility and has a low water-holding capacity. The spring of 1960 was unusually cool and late, with snow covering the ground through most of March. Precipitation during the 1960 growing season was less than normal; however, its distribution throughout the summer was favorable for seedling establishment and growth. The first-year defoliation of the hardwood vegetation ranged from 30 to 90 percent and averaged 64 percent.

Reducing hardwood overstory increased total herbage production from 50 pounds per acre the previous year to 400 pounds per acre the first year after spraying. This increase was mainly less desirable grass, sedge, and forb species. Herbage production was increased to about 600 pounds per acre

on plots seeded to native grasses and to nearly 1,000 pounds per acre on plots seeded to fescue and lespedeza. The first-year production of K-31 fescue was much greater than the production of the seeded native grasses.

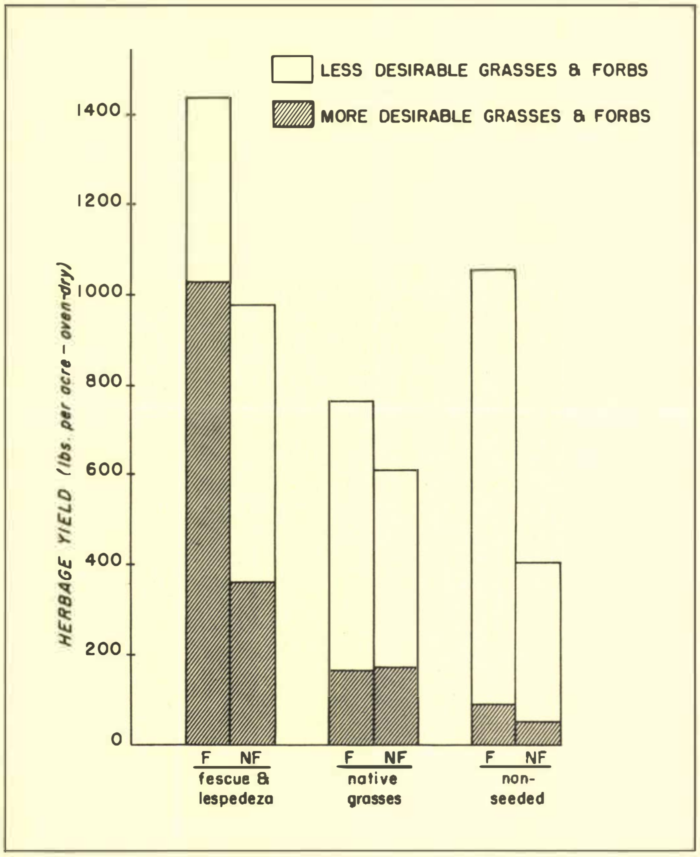


Figure 1.--First-year herbage production (in 1960) on fertilized (F) and non-fertilized (NF) areas seeded to fescue and lespedeza, and to native grasses, and non-seeded areas where the brush had been controlled by spraying with 2,4,5-T.

Fertilizer increased herbage production on all plots (fig. 1). On non-seeded plots the increase was mostly less desirable grasses, sedges, and forbs. In contrast, on plots seeded to fescue and lespedeza, the increased production was mostly these desirable forage species. Fertilizing plots seeded to native grasses caused no increase in desirable forage production. However, there appeared to be better seedling establishment of native species on fertilized than non-fertilized plots. Seeded, native, warm-season grasses generally became established more slowly than introduced, cool-season grasses; however, once established, the seeded stands of native grasses may produce more forage than the seeded fescue stands. The first-year seedlings of cool-season fescue were apparently better able to utilize commercial fertilizer than the native, warm-season species.

Fertilizing areas seeded to K-31 fescue and lespedeza resulted in a threefold increase in total yield of fescue and other desirable forage plants and a marked decrease in herbage production from the less desirable forage plants. The latter was probably due to increased competition from the fescue. In fact, on some fertilized plots fescue production increased to the point where it crowded out the seeded lespedeza.

First-year results of this study show that forage production on over-grazed Ozark forest ranges can be increased. Large increases in forage were obtained by seeding adapted forage species and fertilizing following chemical control of the woody vegetation.

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STATION NOTE

No. 151
September 1961

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio R. D. Lane, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

EUROPEAN ALDER: A PROMISING TREE FOR STRIP-MINE PLANTING

European alder, (*Alnus glutinosa* (L.) Gaertn.) widely used for reclamation planting in Europe[1], seems to be suitable for planting on strip-mined land in the central United States. The species is well adapted to acid spoil, and after 3 years its survival and growth in our experimental plantings are excellent.

In the spring of 1958 we planted several hundred European alder seedlings in seven experimental plots in Kentucky and Ohio[2]. In Kentucky the alder was planted near London on ungraded banks that remained after the Lily coal had been mined. In Ohio we planted the trees in two Hocking County areas from which the Middle Kittanning coal had been taken. The Ohio banks had been graded nearly level. All sites were acid with average pH ranging from 3.0 to 4.6 and individual readings as low as 2.4.

After three growing seasons survival and growth of these alders were very good on all but the most acid parts of the plots. Almost no living trees were found where the pH was 2.6 or lower (table 1). The minimum pH at which a good growth rate is attained seems to be about 3.5; at this level the alder grew an average of 1 foot per year in height, faster than any species planted on Ohio banks except perhaps black locust (*Robinia pseudoacacia* L.)[3]. Where pH is higher, growth and survival are even better, and in both states the best trees are more than 14 feet tall and 1 inch in d.b.h.

On the basis of European experience we anticipate that European alder will be a valuable nurse species. If so, it is a likely prospect to succeed black locust which has for years been the "standard" nurse tree on strip-mined land.

1/ Kohnke, Helmut. The black alder as a pioneer tree on sand dunes and eroded land. Jour. Forestry 39: 333-334. 1941.

2/ These plantings were established with the cooperation and assistance of the Ohio Reclamation Association, the Kentucky Reclamation Association Inc., the Kentucky Department of Conservation, and the Wayne National Forest.

3/ Finn, Raymond F. Ten years of strip-mine forestation research in Ohio. U.S. Dept. Agr., Forest Serv., Cent. States Forest Expt. Sta. Tech. Paper 153, 38 pp., illus. 1958.

Table 1.--Three-year survival and total height of European alder as related to pH at time of planting

pH	Survival	Total height
	Percent	Feet
3.0	28	2.8
3.3	47	2.8
3.4	69	6.9
4.3	86	9.2
4.4	96	10.4
4.5	83	5.9
4.6	92	5.6

Alder is similar to locust in some respects and better in others. Both are nitrogen fixers and both survive well and grow well in acid spoil. Alder, however, does not root-sprout[1], while locust root-sprouts prolifically, often spreading to crowd out interplanted trees. Moreover, alder does not seem plagued by serious insect pests as the locust is. (A wooly aphid was common in part of the Kentucky plantings but caused no apparent damage.) Finally, alder has a narrower crown and better form than locust, hence produces less shade and potentially more commercial timber.

All things considered, European alder looks like a promising species for strip-mine plantings.

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STATION NOTE

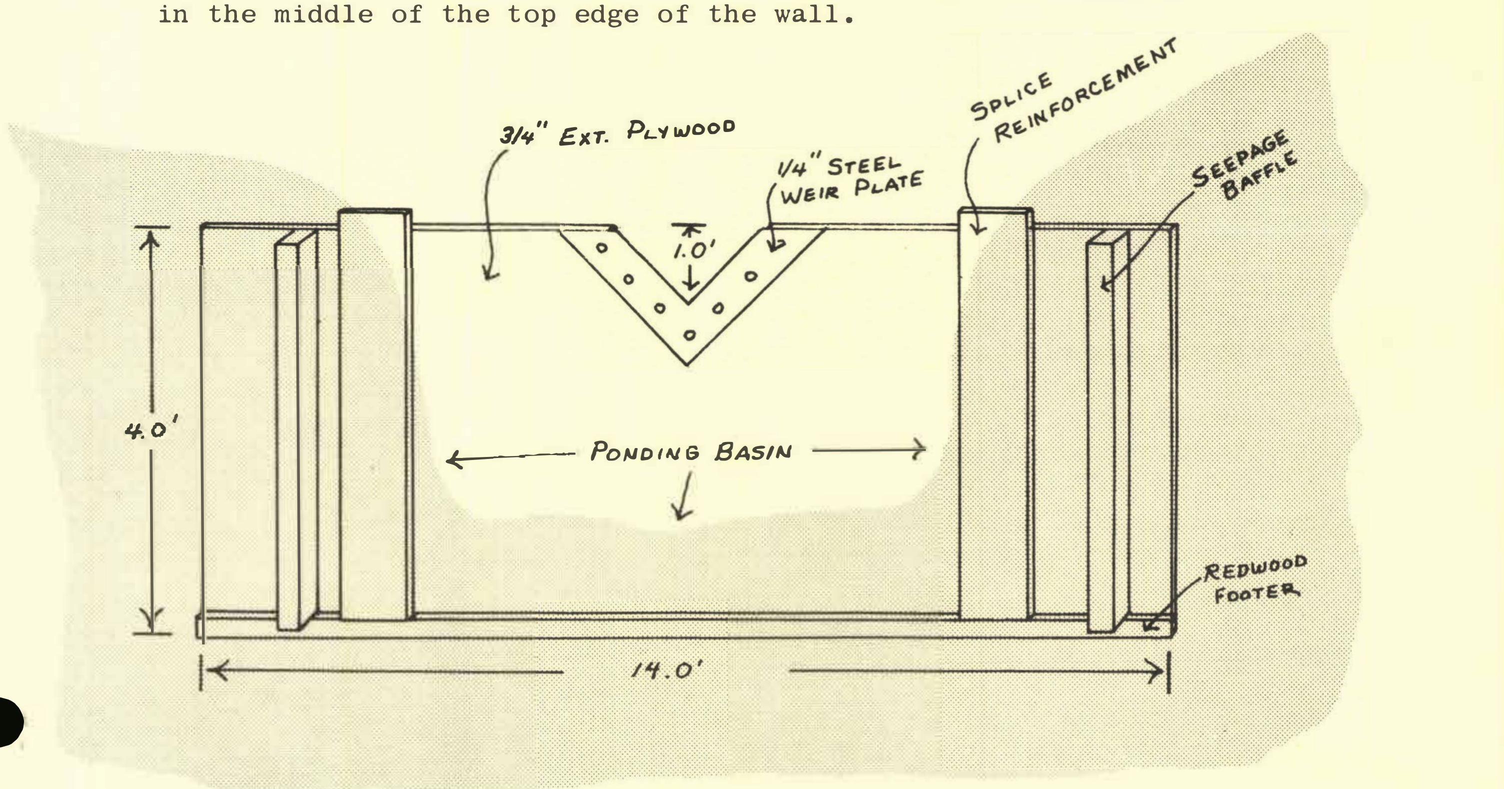
No. 150
August 1961

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio
R. D. Lane, Director
U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

PLYWOOD CUTOFF WALLS FOR TEMPORARY WEIRS

Plywood cutoff walls can be used in place of concrete where the trouble and expense of building a permanent stream-gaging structure are not warranted and where there is little sediment or debris. We have used plywood cutoff walls successfully for 18 months on two 20-acre forested watersheds in eastern Ohio. This is how to build such a weir.

Use standard 3/4-inch, 4- by 8-foot plywood sheets. If your wall needs to be longer than 8 feet, splice additional pieces of the necessary length to the ends of one sheet. Make the joints by covering both sides of the seam with 1- by 4-foot strips of plywood, fastened with resorcinal glue and screwnails. The strip on the upstream side should end far enough above the bottom edge to allow a 4- by 4-inch wood footer to be attached along the bottom. Make two seepage baffles by laminating five 4-inch by 4-foot strips of plywood together and fastening to the upstream side about 2 feet from each end. Again, these should be offset enough to allow for the footer. Next spike the footer (a 4- by 4-inch redwood stringer as long as the finished wall) to the bottom edge of the upstream side. Finally cut a 45-degree notch, 30 inches wide and 15 inches deep, in the middle of the top edge of the wall.



Schematic view of installed plywood cutoff wall--upstream face.

To protect the exposed edges from early deterioration, paint all cut edges with a thin coat of resorcinal glue. When this hardens, treat the entire sheet with two coats of commercial water repellent preservative and two coats of marine spar varnish. This completes the cutoff wall.

At the proposed gaging site, clean the stream channel down to impervious material and widen to form a ponding basin. Next, cut a trench about 1 foot longer and deeper than the dimensions of the wall across the downstream edge of the pool and into the adjacent banks. Be careful to keep the trench at right angels to the channel. Place the cutoff wall in this trench, plumb, and firmly pack with clay. Backfill the downstream face of the wall with earth and bolt a 1/4-inch, steel V-notch blade of appropriate size to the upstream face of the wall, and the job is done.

We used two types of plywood in our own temporary weirs: standard exterior plywood (5 ply) and exterior plywood (5 ply) overlaid on both sides with impregnated paper. The latter appears to be better for this type of cutoff wall.

Equally as important as choice of material in the cutoff wall is the type of opening through which the water flows. Our watersheds are located in a well-protected, undisturbed hardwood forest. The stream channels are well stabilized and low flow prevails throughout most of the year.

Our experience so far shows that the 90-degree, sharp-crested blade on the plywood wall assures sensitive, low-flow measurements. So far, the maximum flow has been 38.51 cubic feet per second per square mile (0.79-foot stage) and the minimum flow 0.005 cubic foot per second per square mile (0.02-foot stage). Volumetric measurements of discharge were made down to 0.04-foot stage and these have checked closely with the theoretical values given by the equation: $Q = 2.5\ H^{2.47}$ where Q is discharge in cubic feet per second and H is stage in feet. To us, this implies similarity in the friction coefficient between our plywood cutoff wall and that of the material used in deriving the original weir equation.

Based on our experience then, we feel that plywood can be used successfully for temporary cutoff walls in small watersheds where physical damage from sediment and debris is no problem.

Ronald Z. Whipkey, research forester
Central States Forest Experiment Station
New Philadelphia, Ohio (field office
maintained in cooperation with the
Muskingum Watershed Conservancy District)

No. 149
June 1961

STATION NOTE

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio
R. D. Lane, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

Promoting the spread of bigtooth aspen in Iowa

The increasing demand for fast-growing species for box lumber, pulpwood, veneer corestock, and lumber could make bigtooth aspen (Populus grandidentata Michx.) commercially important in Iowa if the species were more abundant. In eastern Iowa aspen occurs in small, scattered "pockets" and may attain a diameter of 18 inches and a merchantable height of 2 1/2 to 3 logs in about 50 years. A tree this size would contain about 55 cubic feet of wood.

PROBLEM STUDIED

In 1957, a study was started at the Amana Experimental Forest in cooperation with the Amana Society to find ways of creating conditions favorable for the spread of these aspen pockets at the expense of the low-grade black oak, hickory, hackberry, and elm that typically make up a large part of the surrounding timber stands (fig. 1).

Four similar pockets of bigtooth aspen averaging 1/4 acre in size were chosen for study. The aspen was cut on two of the pockets and left on the other two. Trees on half the area surrounding each pocket (to a distance of 100 feet from the edge of the pocket) were cut and those on the other half poisoned. Poisoning was done with a 4-percent mixture of 2,4,5-T in fuel oil applied as a basal spray. Stems less than 1 inch in diameter were cut and the stumps sprayed. Part of both the clearcut and poisoned areas was disked, using a 4-blade (serrated or tooth-type) disk pulled by a crawler tractor.

Figure 1.--Bigtooth aspen pocket surrounded by low-quality, second-growth timber.

TREATMENTS EFFECTIVE

Three years after cutting the aspen and removing the surrounding hardwood trees, the number of aspen sprouts or seedlings in the area surrounding the pockets had increased from about 40 to 5,000 per acre - about five times as many as were around the uncut aspen pockets. Whether the surrounding stand had been cut or poisoned, disked or not, made no difference in the results. Although the number of new sprouts was greatest near the parent stand, some of the sprouts were more than 90 feet from the edge of it.

From these results the following recommendations can be made.

Where it is desirable to replace existing low-grade hardwoods in Iowa with fast-growing bigtooth aspen, the size of the small aspen pockets can be increased by (1) clearcutting the present aspen trees and (2) cutting or killing the adjacent "other hardwoods." Whether the adjacent trees are cut or poisoned would depend on their merchantability.

Aspen is normally a "fast-starting" species, so it will usually be able to outgrow the lush cover of weeds, grasses, brush, and stump sprouts that commonly follows clearcutting in Iowa.

Alan W. Green, research forester
Central States Forest Experiment Station
Ames, Iowa (field office maintained in
cooperation with Iowa State University)

STATION NOTE

No. 148
June 1961

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio R. D. Lane, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

Seeded Black Walnut Taller Than Planted Walnut on Kansas Spoil Banks

Direct-seeded black walnut (Juglans nigra L.) trees survived as well as and grew faster than planted trees for 10 years in a study on Kansas spoil banks.

The study was begun in 1950 on 4-year-old spoil banks in Cherokee County, Kansas. The banks are loose, shaly clay and average about 20 feet high and 80 feet from crest to crest. At time of seeding the pH was about 7.5 and there were few toxic acid spots. Stratified walnut seeds collected in Missouri were planted in spots 7 feet apart, three seeds to a spot. The following spring, spots where all three seeds failed to germinate were planted with 1-0 nursery-grown walnut stock. These seedlings were grown from seeds collected in both Kansas and Missouri.

In some of these spots delayed germination of the seeds planted the year before ultimately resulted in trees of both seeded and planted origin. In 1954 the groups were thinned to one tree per spot. Since trees of planted origin were less numerous, they were favored to provide a better opportunity to compare the development of direct-seeded and transplanted trees.

Ten years after planting, a 1500-tree sample showed that the trees from direct-seeded walnuts were significantly taller than the planted trees (at the 5-percent level), but there was no great difference in survival or form between them. Average height of the direct-seeded walnut was 6.6 feet, 1.3 feet taller than the planted trees. Eighty-two percent of the direct-seeded trees and 79 percent of the planted walnut were still alive.

The direct-seeded walnut probably grew faster because walnut is a taprooted species. Many of the long taproots of nursery-grown stock are cut or broken when the seedlings are lifted from the beds; when planted in the field, such trees usually develop lateral roots. On dry sites these roots may not be as effective in reaching moisture as the deeper penetrating taproots.

Kenneth W. Seidel, research forester
Central States Forest Experiment Station
Columbia, Missouri (field office maintained
in cooperation with the University of Missouri
Agricultural Experiment Station)

STATION NOTE

No. 147
June 1961

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio R. D. Lane, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

Climatic Injury Found on Planted Black Walnut in Kansas

A dieback that resembles sunscald has been found recently on planted black walnut (Juglans nigra L.) in southeastern Kansas. Twenty to 25 percent of the trees in a pruning experiment were injured and damage was so severe that many of the affected trees will not produce even low-quality lumber. Ring counts of callus growth date the damage as occurring during or after the 1954 growing season and before the 1955 growing season.

The fairly open, pure walnut planting is located on partially graded strip-mined land. The trees were 19 years old when damaged and averaged about 5 inches in diameter at breast height. Similar injuries were found in another plantation about 15 miles from the study plots. But other walnut plantings 10 years younger, established on strip-mined land in northeastern Oklahoma, southeastern Kansas, and southwestern Missouri, were essentially injury free.

On some trees the tops died back and on others long patches on the main stem died. Both types of injury were found on a few trees. Most of the injured trees sprouted profusely (fig. 1). Although callus growth has been rapid, most wounds have not closed in 5 years. Emergence holes of wood-boring insects were common in exposed wounds.

Figure 1.--Most injured trees had many sprouts.

Dieback was most common on the west side of the boles but injuries were found on all sides. Injury was just as extensive on east slopes as on the more exposed south and west slopes. Injuries occurred on pruned and unpruned trees alike. According to daily weather records[1] for 1954 and 1955, maximum temperatures were more than 110° F. several days in July 1954. Although high temperatures are not uncommon in the area, the temperatures in July and August 1954 were extreme. In January 1955 two days with a maximum temperature of 60° F. were followed by several days with a temperature as low as 6° F. In February a period of several weeks with temperatures as high as 80° F. was followed by a sharp drop to 12° F. The sap of walnut is active in warm, winter days in southeastern Kansas and the trees may have been susceptible to winter injury. This climatic injury will greatly reduce the quality of many trees in the affected area.

F. Bryan Clark, research forester
Central States Forest Experiment Station
Bedford, Indiana
Kenneth W. Seidel, research forester
Central States Forest Experiment Station
Columbia, Missouri (field office maintained in cooperation with the University of Missouri Agricultural Experiment Station)

1/ Weather data were supplied by the Pittsburgh and Midway Coal Mining Company.

STATION NOTE

No. 146
June 1961

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio R. D. Lane, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

Pin and Willow Oak Seedlings Can Persist Under a Forest Canopy

A recent study showed that some pin and willow oak (*Quercus palustris* Muenchh. and *Q. phellos* L.) seedlings live at least 30 years under a crown canopy. However, many of the seedlings were misshapen from repeated dieback and sprouting. This information was obtained by studying the reproduction in bottomland stands in southeastern Missouri; it is similar to that found by Merz and Boyce for upland oaks in Ohio. [1]

The overstory trees in the study areas were pole and small-sawtimber size, about 35 years old. The stands had been thinned 3 years earlier to basal areas ranging from 40 to 80 square feet per acre. Of 316 pin oak seedlings collected, we found, by sectioning the stems at the root collar, that 18 were 1 year old, 183 were 2 years old, 86 were at least 5 years old, and 39 were at least 10 years old. The oldest pin oak "seedling" (34 years) was less than 1 foot tall and as old as the overstory trees. Of 35 willow oaks sampled, only 1 was 1 year old, 17 were 2 years old, and the remaining 17 were from 6 to 31 years old.

There was little relation between age and height of the pin oak seedlings 3 years of age and older because of repeated dieback of the tops. Most seedlings died back some distance above the root collar and resprouted from lateral buds. Thus, after several diebacks, many stems were crooked and forked.

Observations made in openings in pin and willow oak stands indicate that seedling-sprouts of these species will respond to release. Roots of some of the seedlings examined consistently showed high starch reserves, suggesting that there is the capacity to increase growth. However, we do not know if enough seedling-sprouts would actually develop into well-formed trees to regenerate these stands in the future.

John E. Krajicek, research forester
Central States Forest Experiment Station
Carbondale, Illinois (field office maintained in cooperation with Southern Illinois University)

1/ Merz, Robert W. and Boyce, Stephen G. Age of oak "seedlings." Jour. Forestry 54(11): 774-775, illus. 1956.

Reg.

No. 145
March 1961

STATION NOTE

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio R. D. Lane, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

ESTIMATING GROWTH FOR LARGE CENTRAL STATES FOREST AREAS

Wanted: Inexpensive, but well-founded estimates of volume growth for extensive forests in the Central States.

Such estimates can be made from the graphs that follow, along with volume information presented in the Forest Survey Release for your area.[1]

FOR EXAMPLE

A timber-growth estimate is required for ten counties in southeastern Iowa as part of a land-use evaluation study. Instead of making a costly ground survey, it is decided that existing Forest Survey data will be utilized.

Along with other information, Forest Survey Releases provide estimates of forest area by county and estimates of average board-foot and cubic-foot volume per acre for states and sections of states. Referring to the release that includes forest statistics for southeastern Iowa,[2] we find that the ten counties in question have a total commercial forest area of 492,000 acres--and that the average volumes per acre for this section are 1,441 board feet and 420 cubic feet.

Average growth estimates corresponding to these volumes on the graphs are 68 board feet and 21.5 cubic feet per acre. If personal knowledge of the area involved suggests that growth there may average more or less than the regional average, one or the other of the extremes may be used. Total volume and growth are obtained by multiplying per-acre figures by the total forest acreage.

NOTES

"Net growth" is volume growth on the present stand, plus ingrowth, minus mortality.

Net growth per acre at "zero" average volume per acre represents the average initial ingrowth for stands that will have their first board-foot or cubic-foot volume within 1 year.

1/ Survey Releases may be obtained from the Central States Forest Experiment Station, 111 Old Federal Building, Columbus, Ohio.

2/ Iowa Forest Statistics. U.S. Dept. Agr., Forest Service, Cent. States Forest Expt. Sta. Forest Survey Release 20, tables 28 and 37. 1956.

Growth differences between the areas are in large part attributable to differences in:

(a) average merchantable height of trees
(b) diameter distributions in the stands

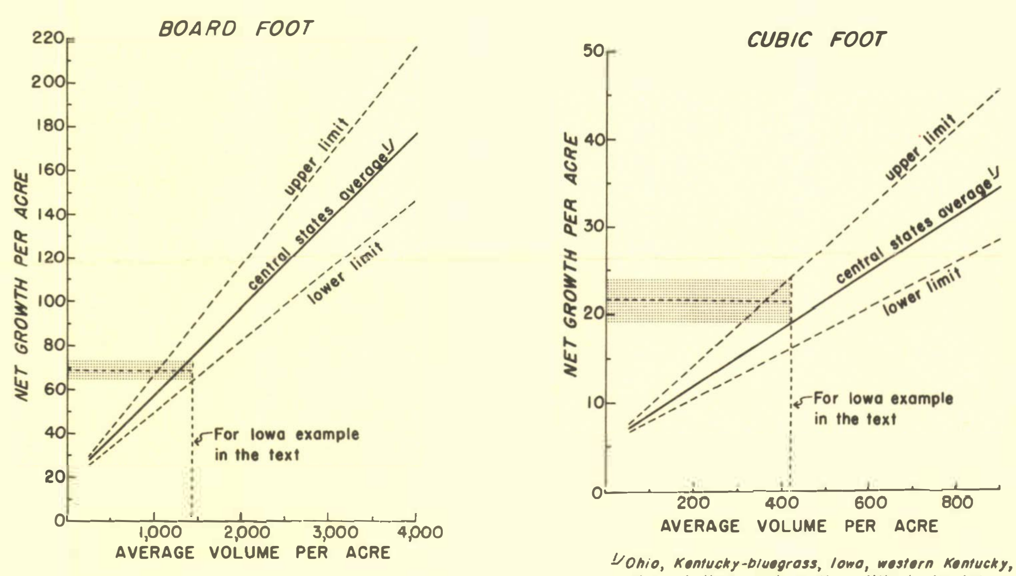
The latter is responsible for much of the fluctuation within states on the cubic-foot graph (see footnote to table).

See Survey Releases for definition of sawtimber, etc., and for more detailed description of the areas mentioned in the graphs.

CAUTION

The growth estimates are most reliable for the average stands and sites of the large areas designated on the graphs. Do not use this estimating method for areas less than three counties in size and for areas that have been subjected to planned timber management for any length of time.

Chester E. Jensen, mathematical statistician
Central States Forest Experiment Station
Ames, Iowa



[1] Ohio, Indiana, and Kentucky trends lie between the all-state average and the "upper limit." Missouri, Iowa, and Illinois trends lie between the all-state average and the "lower limit."

[1] Ohio, Kentucky-bluegrass, Iowa, western Kentucky, southern Indiana, and southern Illinois lie between the all-state average and the "upper limit." Eastern Kentucky, Illinois-claypan, Missouri, Illinois-prairie, and northern Indiana lie between the all-state average and the "lower limit."

Relation between volume and growth per acre
(basis: 13,100 field plots)

No. 144
December 1960

STATION NOTE

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio
R. D. Lane, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

Cutting Short Bolts Means More Wood --
But More Work, Too

The use of hardwoods for pulp and paper is increasing. Within the last few years nearly all pulpmills in the central states that formerly used straw began using hardwoods. One source of this material is from the tops of trees cut for sawlogs. At the Kaskaskia Experimental Forest, in exploring the possibilities of integrated sawlog-pulpwood logging, we found how bolt length affects the volume obtained and the work involved.

We measured 60 hardwood tree tops[1] to find the cubic foot volume of wood recoverable in either 4- or 7 1/2-foot lengths. (We used 7 1/2-foot lengths--instead of 8-foot--to permit a safety margin for hauling the wood on a truck in Illinois where 8-foot width of loads is the maximum permitted.) The study trees had been cut for sawlogs to a minimum 8-inch top (inside bark). Minimum utilization for pulpwood was 4 inches diameter outside bark.

By cutting 4-foot bolts rather than 7 1/2-foot bolts, we found that 34 percent more wood could be recovered from the tree tops. Cutting the shorter lengths, however, increased the square feet of cutting surface by 159 percent and the number of bolts to be handled by 165 percent (table 1). Thus, the length of bolt cut significantly affects the amount of pulpwood that can be produced and the amount of labor required to produce it. Unless the entire operation can be done efficiently, the higher cost of production per cord for the shorter bolts may more than offset the value of the added volume produced.

Jmg
JW

1/ Seven tree species were used: white oak (*Quercus alba* L.), black oak (*Q. velutina* Lam.), scarlet oak (*Q. coccinea* Muenchh.), sycamore (*Platanus occidentalis* L.), hickories (*Carya* spp.), elms (*Ulmus* spp.), and yellow-poplar (*Liriodendron tulipifera* L.).

Table 1.--Pulpwood yield from 60 hardwood tree tops by cutting 4- or 7 1/2-foot lengths to a 4-inch top diameter

Bolt length (feet)	Volume recoverable	Bucking area	Bolts	Volume per tree
	(cu. ft.)	(sq. ft.)	(number)	(cu. ft.)
4	985.7	256.5	825	16.4
7 1/2	736.6	99.3	311	12.3

Ronald W. Jokerst, forest products technologist
Central States Forest Experiment Station
Carbondale, Illinois (maintained in cooperation with Southern Illinois University)

STATION NOTE

No. 143
July 1960

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

YELLOW-POPLAR SEEDFALL PATTERN

Knowing the pattern of seedfall can be helpful when trying to regenerate yellow-poplar. This is especially true if the stand contains only scattered yellow-poplar seed trees. Information obtained from seed collections in Indiana shows that most of the seed falls north and northeast of seed trees.

The study was conducted in a mixed hardwood sawtimber stand located in the unglaciated hill country of southern Indiana. The most numerous species were sugar maple, hickories, white ash, white oak, and red elm. Yellow-poplar trees were scattered throughout the stand. A few dominant ones were spaced far enough apart for distribution patterns to be studied.

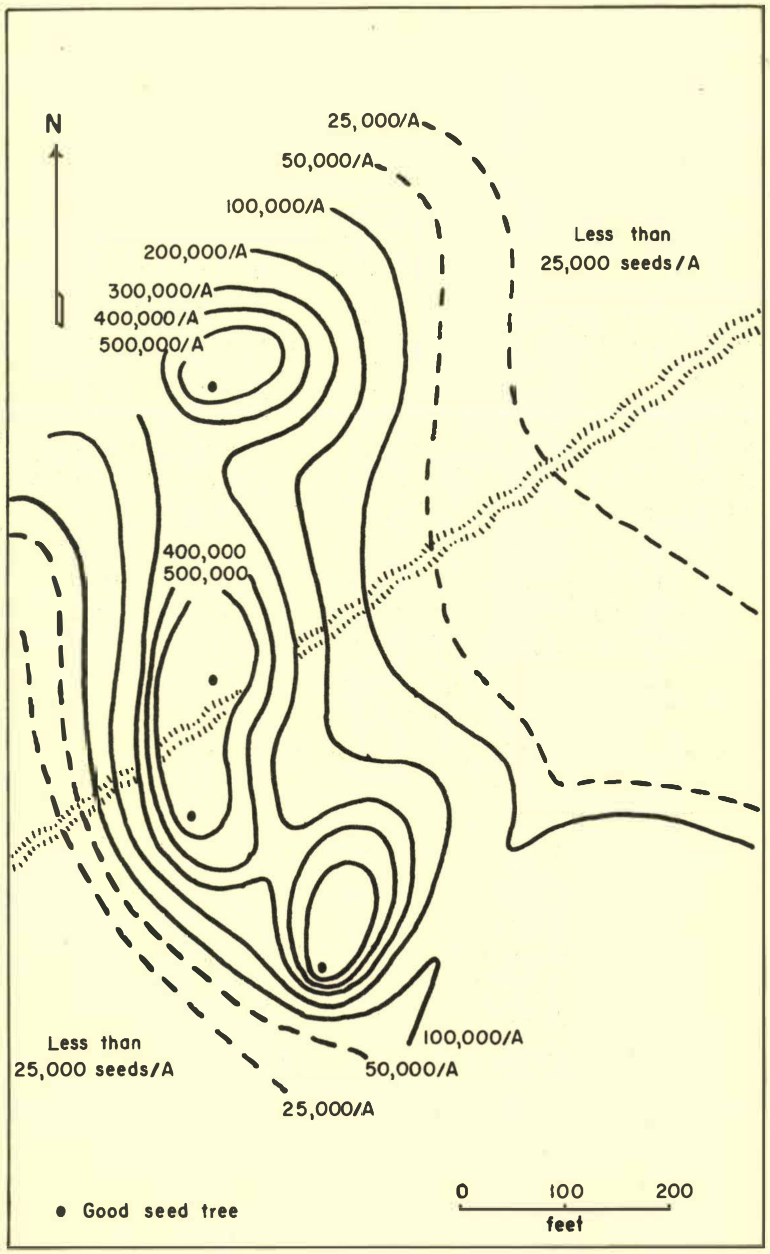
Seeds were collected in 220 seed traps on 11 acres of plots through the fall and winter of 1958-59 and 1959-60. Each year the seed count for each trap was plotted on a map of the study area. After the data were plotted all yellow-poplar seed trees were located on the map and lines of uniform seeding density were drawn. Seeding patterns for the two seasons were nearly identical, so the data were combined.

The seedfall from each tree was distributed in an oval pattern, the long axis of the oval running generally north and south and the center lying north of the seed tree (fig. 1). Over 1/4 million seeds per acre fell on about 1/3 to 1/2 acre beneath and to the north of a good seed tree, but seedfall density decreased rapidly with increasing distance from this area. Density was less than 50,000 per acre beyond about 150 feet south and southwest of a good seed tree and about 350 feet north and northeast of the tree. But occasional seeds were found over 600 feet from a tree in the latter direction. Seedling counts made in the fall of 1959 indicated that a seed density of 50,000 per acre was enough for adequate yellow-poplar stocking even though seed viability was only about 7 percent.

The seeding pattern can be explained by prevailing weather conditions. In a study in North Carolina[1] it was found that the rate of seedfall was highest during periods of high temperature or low rainfall in the late autumn. In Indiana, south to southwest winds prevail at such times. The rate of seedfall is reduced during periods of cool, wet weather when the winds are usually out of the north and northeast. However, abnormal winds may cause a different pattern of seedfall in any one year. Local topography can also modify the effects of the wind in any particular area.

1/ Carvell, Kenneth L. and Korstian, C. F. Production and dissemination of yellow-poplar seed. Jour. Forestry 53: 169-170, illus. 1955.

Figure 1.--Pattern of annual yellow-poplar seedfall on part of the study area showing lines of equal seeding density.



It appears then that in stands with scattered yellow-poplar trees, group or patch cutting should usually be done north and northeast of a seed tree to obtain maximum yellow-poplar reproduction. No special supplementary measures are needed near the seed tree. In the intervening areas of light seedfall, however, extra ground scarification would help boost seedling establishment. Knowledge of the seeding pattern can thus be used to increase the amount of yellow-poplar in the new stand.

LaMont G. Engle, research forester
Bedford, Indiana

STATION NOTE

No. 142
July 1960

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

USABLE FORAGE UNDER PINE STANDS?

We know that yield of herbaceous vegetation in Missouri shortleaf pine stands increases as stand density decreases. However, until recently we did not know whether enough forage could be produced under young pine stands to make grazing worthwhile and still retain a stand of sufficient density for good pine production. Observations show that usable amounts of forage are produced under relatively open pine stands thinned to 50 square feet basal area, but much lower yields of forage are obtained under more dense stands of pine.

Herbaceous vegetation was observed from 1951 through 1958 in pine stands of various densities on the Sinkin Experimental Forest in southern Missouri. The area was in open range and was grazed before and during the study. Before 1933 the area was periodically burned. Land in the study area is rolling with slopes of from 4 to 30 percent. The soil is classed as Clarksville stony loam.

This natural pine stand was established about 1920. Before thinnings were made in 1951 there were about 570 pine trees per acre with an average d.b.h. of 5.7 inches and a basal area of about 130 square feet.

Fifteen 1/2-acre plots were used. Three were thinned to each of four basal areas, 50, 70, 90, or 110 square feet per acre and three were left unthinned as a check (130 square feet per acre). All hardwoods were removed from the entire study area. Herbage yields were estimated on four permanent milacre quadrats in each plot. Estimates were made in September of each year according to the procedure described by Pechanec and Pickford, 1937.[1]

Large increases in forage were only obtained in the heavily thinned stands (fig. 1). Total herbage yield increased 4 to 5 times as basal area was decreased from 130 square feet to 70 square feet per acre. However, total herbage production in the stands of 50 square feet basal area increased to more than 14 times the yield from unthinned stands. There was a delay of several years before peak production was attained. This was probably because herbage cover on the area before release was sparse and precipitation during the 1952-1955 growing seasons was low.

1/ Pechanec, Joseph F. and Pickford, G. D. Weight estimate method for the determination of range or pasture production. Jour. Amer. Soc. Agron. 29(11): 894-904. 1937.

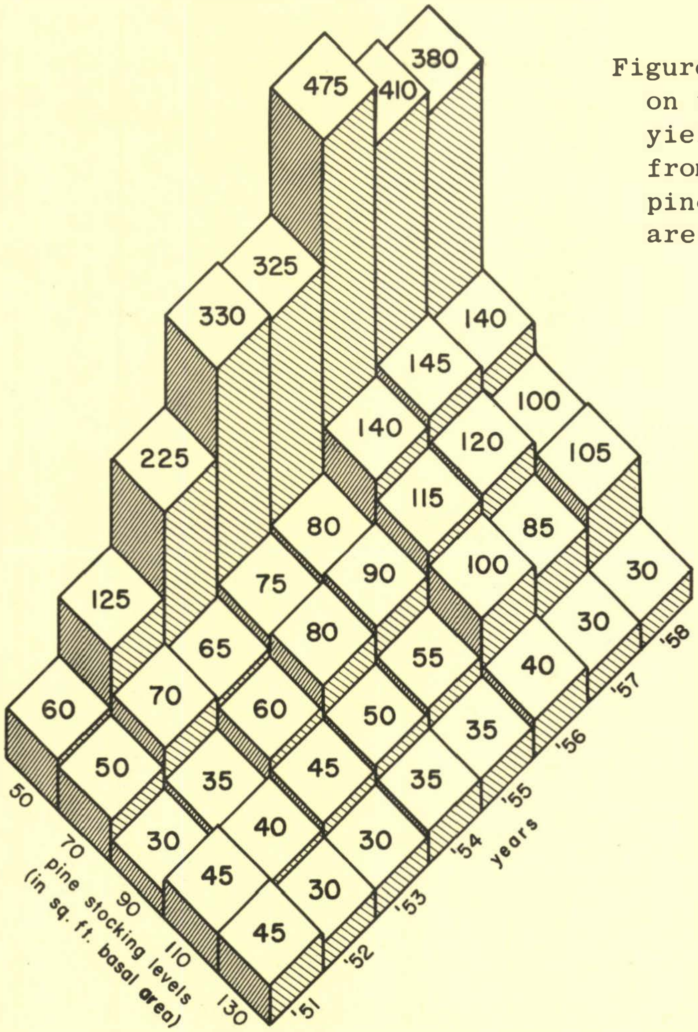


Figure 1.--Herbage production (figure on top of each column is average yield in pounds per acre, oven-dry) from 1951 through 1958 in shortleaf pine stands thinned to various basal area densities in early 1951.

Most of the herbage increase in heavily thinned pine stands was little bluestem and other palatable grasses, such as Indiangrass, big bluestem, and bluegrass. Average yield of little bluestem increased 50-fold, from 4 pounds per acre in the unthinned stands to about 200 pounds per acre in heavily thinned stands. Legumes and other forbs did not respond to the heavy thinnings as much as the grasses did; average yield of legumes increased only from 10 pounds per acre in the unthinned stands to 40 pounds per acre in heavily thinned stands and average yield of other forbs increased from 15 to 100 pounds per acre.

Although board-foot production was not as great in heavily thinned stands as in stands with 70 square feet basal area per acre, production still was good and the areas also yielded enough forage for cattle grazing. Moderate grazing in such stands would require about 16 to 24 acres to support one cow for a 5-month summer grazing season. This study indicates that there is enough forage in low-density pine stands to make grazing worthwhile; the next step is to find the best way to use this forage consistent with good land management.

John H. Ehrenreich, range conservationist
Columbia, Missouri (research center maintained in cooperation with the University of Missouri, Agricultural Experiment Station).

STATION NOTE

No. 141
May 1960

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

Occurrence of the Chlorotic Dwarf Disease in Some Ohio White Pine Plantations

The chlorotic dwarf disease of the eastern white pine (Pinus strobus L.) is primarily characterized by premature defoliation, systemicly decreased plant growth, and stunted, chlorotic needles. The disease intensifies yearly until the plants are killed.

The disease has been known for approximately 50 years and is found throughout most of the white pine range. Seedlings and young trees to about 15 years old and rarely to 40 years old are most commonly infected. The attacked pines occur individually or clustered in a random distribution throughout the plantings.

In 1959 surveys were begun in Ohio forest plantations to determine the severity of the chlorotic dwarf disease. To obtain adequate sampling it was proposed that 10 percent of the initial planting be inspected. However, in numerous instances almost the entire plantation had to be checked to obtain the minimum requirement because many trees had died since the plantation inception.

A composite sampling was obtained by examining sections of the plantations and classifying the pines as healthy, questionable, or diseased. The last group possessed all the typical chlorotic dwarf symptoms, whereas the questionable ones did not.

A total of 25,880 white pine plants were checked on 43 Ohio plantations: 22,702 healthy, 1,622 questionable, and 1,556 diseased plants were found. About 7 percent of the trees in the 3-to-15-year-old plantations were diseased. The percentage represents a minimum value because (1) dead chlorotic dwarf trees found in all plantations were not tabulated, (2) questionable plants are not included in the disease percentage, and probably many of these plants will be infected with chlorotic dwarf in subsequent years, (3) even healthy pines have been known to become diseased, and (4) some roguing of inferior plants had been practiced in certain plantations.

Most chlorotic dwarf trees were found in the 3-to-11-year-old plantations (table 1), probably because in older plantations the diseased trees had died.

No correlations were obtained to explain the variations in number of chlorotic dwarf plants when the results of the same age groups from different forests were compared. Since the nursery conditions previous to the establishment of white pine seedlings in the plantations were the same, it may be that certain management

practices or plant-environment relationships are in operation. This inference is supported by the fact that in all plantations incidence of the disease was either low or high.

Further studies are planned to investigate the findings obtained from the surveys.

Table 1.--The occurrence of healthy and chlorotic dwarf diseased white pine trees in Ohio plantations
(In percent)

Condition of trees	Plantation age in years: 3	4-5	6-8	9-11	12-15	16-20
BLUE ROCK						
Healthy	69	83	80	77	84	100
Chlorotic dwarf	20	10	11	11	8	0
Questionable	11	7	9	12	8	0
Total	100	100	100	100	100	100
MOHICAN						
Healthy	98	92	91	94	97	100
Chlorotic dwarf	1	4	4	2	1	0
Questionable	1	4	5	4	2	0
Total	100	100	100	100	100	100
PIKE						
Healthy	95	93	88	92	--	99
Chlorotic dwarf	1	2	5	2	--	0
Questionable	4	5	7	6	--	1
Total	100	100	100	100	--	100
ZALESKI						
Healthy	88	94	90	86	93	95
Chlorotic dwarf	5	3	3	6	3	0
Questionable	7	3	7	8	4	5
Total	100	100	100	100	100	100

Leon S. Dochinger, pathologist
Central States Forest Experiment Station
Columbus, Ohio

STATION NOTE

No. 140
December 1959

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

COOPERAGE LOGS AND BOLTS--PRODUCTION AND CONSUMPTION IN THE CENTRAL STATES--1958

The Central States, long the principal producers of hardwood cooperage logs and bolts in the United States, supply approximately 40 percent of the national requirements.[1] More than 91 million board feet of cooperage timber, principally white oak, with a stumpage value of $3,648,000 was harvested in 1958.[2] Most of this wood was utilized within the Central States.

Missouri Largest Producer.--Missouri alone produced one-third of the entire harvest. Illinois and Kentucky were also prominent producers, each accounting for one-fourth of the harvest (table 1). Eighty percent of the production was white oak. Bur oak and post oak accounted for 10 percent and a group of species including elm, gum, sycamore, hackberry, cottonwood, and others, used to make slack cooperage, accounted for the remaining 10 percent.

Missouri Also the Largest Consumer.--Approximately 83 mills consumed 90.5 million board feet of logs and bolts in 1958. Missouri, with 38 mills, was the leading consumer, accounting for more than a third of the total consumption (table 2). Illinois and Kentucky accounted for one-fourth and one-fifth of the total consumption respectively.

Table 1.--Production of cooperage logs and bolts in Central States by source and destination--1958

(In 1,000 board feet, International 1/4-inch rule or approximately 100 chord feet)

Destination	Source						
	Ohio	Indiana	Illinois	Kentucky	Missouri	Iowa	Total
Ohio	8,538	21	--	41	--	--	
Indiana	41	2,655	1,600	1,083	--	--	
Illinois	--	--	21,641	--	881	435	
Kentucky	--	660	--	18,739	--	--	
Missouri-Iowa[1]	--	--	1,116	2,171	28,924	747	
Exports	--	--	357	222	1,001	315	
Total	8,579	3,336	24,714	22,256	30,806	1,497	91,188
Percent	9.4	3.7	27.1	24.4	33.8	1.6	100.0

1/ Combined to prevent disclosure of individual plant production. Less than 10 percent in Iowa.

1/ U. S. Forest Service. Timber resources for America's future. Forest Resource Rpt. No. 14, 713 pp., illus.

2/ Calculated on basis of $40 per 1,000 board feet, International 1/4-inch rule.

Table 2.--Consumption of cooperage logs and bolts in Central States by source and destination--1958

(In 1,000 board feet, International 1/4-inch rule or approximately 100 chord feet)

Source	Destination					
	Ohio	Indiana	Illinois	Kentucky	Missouri-Iowa 1/	Total
Ohio	8,538	41	--	--	--	
Indiana	21	2,655	--	660	--	
Illinois	--	1,600	21,641	--	1,116	
Kentucky	41	1,083	--	18,739	2,171	
Missouri	--	--	881	--	28,924	
Iowa	--	--	435	--	747	
Imports	--	--	758	2	460	
Total	8,600	5,379	23,715	19,401	33,418	90,513
Percent	9.5	6.0	26.2	21.4	36.9	100.0

1/ Combined to prevent disclosure of individual plant production. Less than 10 percent in Iowa.

Export-Import Difference Relatively Small.--Inter-regional movement of cooperage logs and bolts amounted to 3,115,000 board feet. Incoming shipments, amounting to 1,220,000 board feet, largely from Wisconsin and Kansas, were received by Illinois, Missouri, and Kentucky. Outgoing shipments of 1,895,000 board feet, destined for Arkansas, Tennessee, and Wisconsin, originated in Missouri, Illinois, Kentucky, and Iowa. With a net export of only 675,000 board feet, it is plain that the Central States utilize most of their own cooperage timber and reap the additional economic benefits of the manufacturing process.

Production Sporadic.--Production in 1958 appeared to be slow. Several mills producing in 1959 did not work in 1958 or worked only part of the year. This off-and-on-again activity appears to be typical of the cooperage industry, especially the independent producers, and in part is the reason for the temporary nature of many of these mills.

Biennial Reports to be Made.--This report is the result of the first of a series of biennial canvasses of the cooperage industry. A similar canvass of the 1960 production and consumption will be conducted early in 1961. Information gathered in this and other canvasses is used to calculate the timber cut in the Central States as well as to report developments in the wood-using industries.

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STATION NOTE

No. 139
November 1959

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

Releasing Understory Pine Increased Herbage Production

Herbage production was temporarily increased on oak-pine land sprayed with herbicides to release understory pines. This increase in herbaceous vegetation could benefit both livestock and wildlife.

A study was begun in 1955 to determine how spraying undesirable hardwoods with herbicides to release underplanted pine trees would affect yield of herbaceous vegetation.

This study was made in an oak stand that had been underplanted with pine in 1941. Hardwood cover ranged from dense sprout reproduction and saplings to dominating, cull, sawlog-size trees. Hardwood crown cover was about 90 to 95 percent; about half of this was understory and about half overstory cover. The underplanted pines were from 1 to 25 feet in height. Herbaceous vegetation consisted mostly of little bluestem (*Andropogon sloparius*), poverty oat grass (*Danthonia spicata*), and sedge (*Carex* spp.) with various legumes and other forbs. The soil on the area is Clarksville stony loam.

Aerial and hand applications of herbicides were used in this study. In June 1955, 2,4,5-T was aerially applied at the rate of 2 pounds acid equivalent per acre in 4.5 gallons of fuel oil. The hand spraying was done in July 1955 by applying 2,4,5-T (at 20 pounds a.h.g.) in fuel oil to foliage of trees less than 3 feet tall, to low cut stumps of trees 3 feet tall to 3 inches d.b.h., and to low frills in trees larger than 3 inches d.b.h. Forage production estimates were made on circular plots 3.5 feet in diameter according to the method described by Pechanec and Pickford.[1]

Reducing the hardwood crown cover to about 20 to 30 percent (most of the reduction occurring in overstory) by hand spraying with 2,4,5-T resulted generally in a 5 to 6 fold increase in herbage production for at least 3 years (fig. 1). Aerial spraying increased herbage production by more than 17 times the first year after treatment but production dropped back to slightly less than that on hand-sprayed areas the second and third years.

1/ Pechanec, Joseph F. and Pickford, G. D. Weight estimate method for the determination of range or pasture production. Jour. Amer. Soc. Agron. 29(11): 894-904. 1937.

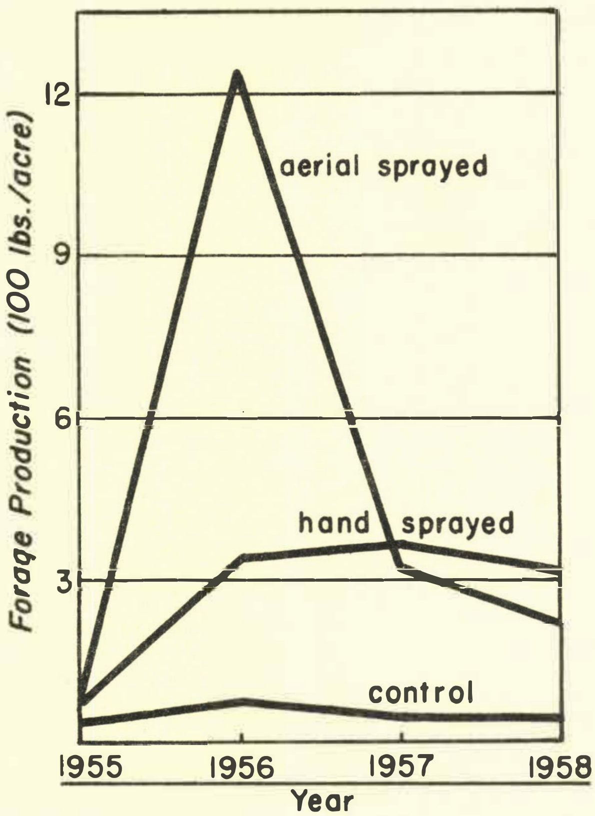

Figure 1.--Forage production on areas sprayed in 1955 with 2,4,5-T to release understory pine.

The reason for this spurt was that aerial spraying quickly defoliated the larger hardwood trees, opening up the stand and providing an immediate stimulus to herbaceous cover. On hand-sprayed areas the larger trees defoliated more slowly because they were killed from the boles instead of the crowns. Competition from the regrowth of hardwoods and rapid growth of released pine decreased herbaceous production the second and third years on aerial-sprayed areas and the third year on hand-sprayed areas.

The temporary increase in herbage production on oak-pine land sprayed to release the understory pine provides a source of forage that could be used by both livestock and wildlife. In the South, forage in pine stands is commonly utilized at various times during the pine rotation by stocking the areas with cattle (Halls et. al., 1956)[2]. Grazing the increased forage in the stands of released pine in Missouri at a time that would not damage the pine would supplement the timber owner's income and help offset the cost of herbicide application.

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2/ Halls, L. K., Hale, O. M. and Southwell, B. L. Grazing capacity of wiregrass--pine ranges of Georgia. Ga. Agri. Expt. Sta., Tech. Bul. N.S. #2. 38 pp., illus. 1956.

STATION NOTE

No. 138
November 1959

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

Direct Seeding.

New Rodent Repellents Fail to Work on Acorns and Walnuts

Direct seeding with repellent-treated coniferous seed has been successful in some regions.1/ But the same chemicals failed to repel rodents from oak and black walnut seed in recent trials in southern Indiana. Although the chemicals failed to reduce rodent pilferage we found that proper timing of seeding may increase chances of seedling establishment.

The test area was a half-acre opening made in an oak-hickory stand. Rodents, especially chipmunks and squirrels, were abundant. Seeds were planted in the spring and fall of 1958 and the spring of 1959. Stratified seed was used in the spring plantings. Acorns were planted 1 inch deep and walnuts 2 inches deep. A total of 2,700 seeds were used in the trials.

Seeds planted in the spring of 1958 were coated with wheat paste slurries containing either (a) endrin (18.9 percent hexachloroepoxyocahydro-endo-endo-dimethanonaphthalene) or (b) thiram (50 percent tetramethylthiuramdisulfide). Seeds planted in the fall of 1958 and spring of 1959 were coated with acrylic binders containing either endrin or thiram. Untreated seeds of each species were also planted in each test as checks.

The combined results of all trials show that the chemicals failed to reduce rodent pilferage. In fact, more seedlings were established with untreated seed. In most spots without seedlings, rodent digging was evident regardless of treatment.

1/ Dimock, Edward J.II. A comparison of two rodent repellents in broadcast seeding douglas-fir. Res. Paper No. 20 PNF & RES. May 1957.

Dick, James, Finnis, J. M., Hunt, Lee O., and Kverno, Nelson B. Treatment of douglas-fir seed to reduce loss to rodents. Jour. Forestry, 56: 660-661.

Meanley, Brooke, Mann, W. F. Jr., and Derr, H. J. New bird repellents for longleaf seed. Southern Forestry Notes, No. 105. September 1956.

One percent of the red oak and 2.5 percent of the white oak acorns planted in the fall of 1958 produced seedlings compared with 9 percent for each species planted in the spring of 1959. This difference was probably due to the longer time that fall-sown seed was exposed to pilferage.

The difference between years was striking. In the spring of 1958, 37 percent of the red oak acorns and 17 percent of the walnuts produced seedlings. But in the spring of 1959 only 9 percent of the red oak acorns and 2 percent of the walnuts produced seedlings.

Pilferage by rodents appeared to be related to mast production and this probably accounts for the difference between years. In 1957 there was a good hickory mast crop and rodent pilferage of the 1958 spring-planted seed was moderate. But the 1958 mast crop was a failure and, with the scarcity of a natural food supply, pilferage of the 1959 spring-planted seed was nearly complete.

Although direct seeding is cheaper than planting, direct seeding acorns and walnuts is still a gamble. But the risk might be less if seeding were done in the spring with stratified seed following a year of good mast production.

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STATION NOTE

No. 137
November 1959

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

Seed Source Affects Height Growth of Planted Jack Pine

Past studies have shown that for several pine species best height growth is obtained on trees grown from seed collected in a climatic zone most similar to that of the planting site. A recent test shows that this is also true for jack pine (Pinus banksiana Lamb.), a species used for planting on old fields and various types of coal strip-mine banks in Indiana.

Seed was collected from 16 natural stands in Michigan, Minnesota, and Wisconsin. These seed sources were grouped by seed collection zones adapted from those developed by the Lake States Tree Improvement Committee.[1] Not all collection zones proposed by the Lake States Committee were represented by the seed sources sampled, nor did growth results warrant using all proposed zones. So the Lake States zones were combined to form a northern zone and a southern zone, each of which is represented by eight seed sources (fig. 1).

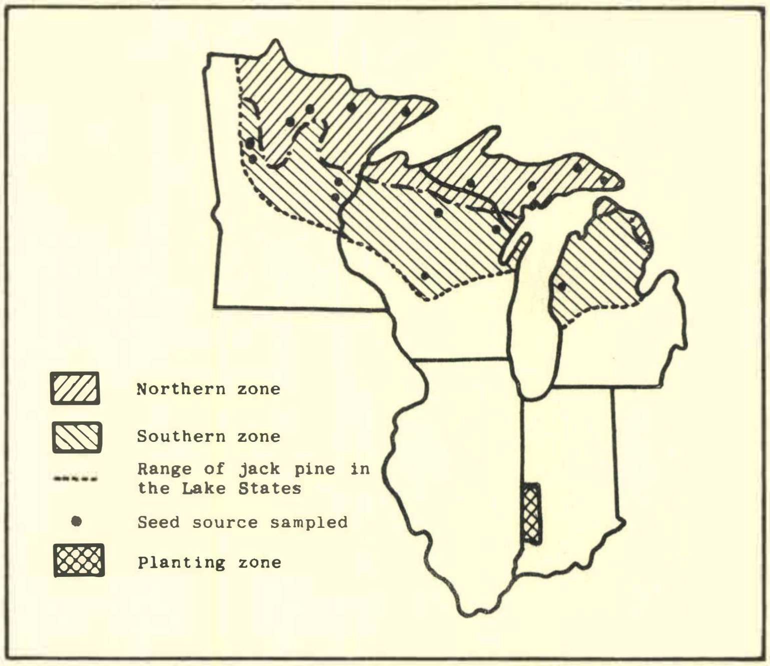

Figure 1.--Proposed jack pine seed collection zones based on the average annual accumulation of normal, average daily temperatures above 50° F.

1/ Lake States Tree Improvement Committee. Forest tree seed collection zones for the Lake States. Forestry Div., Mich. Dept. of Conservation, 14 pp., illus. June 1957.

All seed was sown at Indiana's Jasper-Pulaski State Nursery in 1952. Then in 1954 the 2-0 seedlings were planted in experimental blocks on mine banks and old fields located throughout southwestern Indiana. Each block contained a 1/10-acre plot of trees from each seed source. The trees were planted on a 6 x 6 spacing.

Five years after planting, the heights of the trees on six mine-bank blocks and on one old field block were measured. To reduce variation due to microsite conditions, only the 20 tallest trees from each plot were considered.

Seed collected from the temperature zone most similar to that of the planting site produced the tallest trees. Trees from the southern zone averaged 4.8 feet tall while those from the northern zone averaged only 4.2 feet. Statistically, this difference in height is highly significant.

From these early results it appears that jack pine planted in southwestern Indiana should be from seed collected from the southern zone.

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(This study is maintained in cooperation with the Indiana Coal Association.

STATION NOTE

No. 136
October 1959

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio
W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

Something New on Bur Oak Germination

Some writers have recognized an upland form of bur oak (Quercus macrocarpa Michx.) in addition to the bottomland form, or typical bur oak. Both forms occur in Iowa.

The upland form is found on dry upland sites and its growth and form are generally poor. Its acorns are about half the size of those from bottomland bur oak, and they have smaller and thinner cups. These acorns are reported to germinate in the spring.

The bottomland, or typical, bur oak grows on the more moist bottomland sites where its growth and form are usually good. The acorns are usually large and reportedly germinate in the fall. The results of recent tests show that the time of germination of acorns of the two forms, as stated, may not be correct.

Acorns from four bur oak trees of each form were collected in the vicinity of the Amana Experimental Forest during the 1957 seed fall. After careful testing for soundness, 10 acorns from each seed tree were planted in each of five wooden flats containing moist, sterile sand. The flats were exposed to subsequent fall and winter temperatures and watered as needed to maintain adequate moisture for germination.

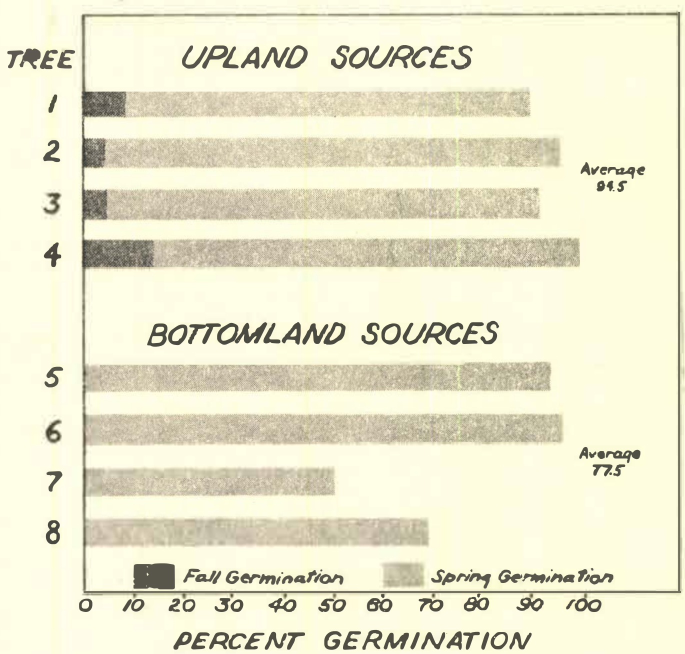

Figure 1.--Percent germination of bur oak acorns by source.

The results of this test did not confirm the earlier reports of the germination times of acorns from trees of the two forms. None of the acorns from bottomland trees germinated in the fall. Of the acorns from upland trees that germinated, 6 percent did so in the fall. (fig. 1).

Further tests are planned to find out the extent to which heredity and environment cause the observed differences in germination and growth habits of the two forms of bur oak.

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(Maintained in cooperation with
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STATION NOTE

No. 135
October 1959

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

Modified Girdler Shows No Advantage

Some foresters have suggested that when girdling and poisoning hardwoods a better kill might be possible by using a girdler modified to cut a J-shaped notch rather than a standard C-shaped notch. Theoretically a J-shaped notch (fig. 1) will hold the herbicide in the girdle, whereas a C-shaped notch allows the herbicide to flow down the trunk. When a group of mixed hardwoods were girdled in southeastern Ohio, however, there was no difference in the kill between the modified girdler and the standard.

In June 1958 more than a thousand trees were girdled on the Vinton Furnace Experimental Forest (maintained in cooperation with the D. B. Frampton Company). Three hundred and sixty-seven trees were girdled using a gasoline-powered tree girdler[1] equipped with a modified handle and guard assembly (purchased from the manufacturer) that is designed to cut a J-shaped girdle notch. Seven hundred and nine trees were girdled using the girdler equipped with a standard handle and guard assembly. Following girdling a commercial herbicide (1 1/3 lbs. 2,4,D and 2/3 lbs. 2,4,5-T acid equivalent per gallon mixed with diesel fuel oil at the rate of one part herbicide to 20 parts diesel oil) was sprayed into the girdles until it formed droplets and started to run down the bark.

A year later it was evident that using the modified girdler did not result in a better kill of the hardwoods; 61 percent of all girdled trees were dead after 1 year regardless of the shape of girdle. (This kill may, of course, increase during the second year.) Moreover, shape of girdle made no difference in the number of trees that sprouted or in the number that bridged over the girdle.

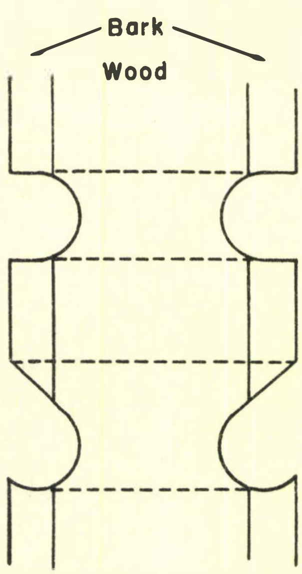

Figure 1.--Diagram of J-shaped notch (bottom) made with the modified girdler and the C-shaped notch (top) made with the standard girdler.

1/ "Little Beaver" manufactured by the Haynes Manufacturing Company, Livingston, Texas.

Furthermore, there was no difference between the modified and the standard assembly in the time needed for girdling or in the amount of herbicide used. We averaged 10.4 minutes and 0.63 quarts per 100 inches of diameter (girdling at the rate of 20.5 square feet of basal area per acre in trees averaging 7.4 inches in d.b.h.).

And finally, the J-shaped notch showed no advantage in holding the herbicide in the girdle. The theory seems good, but in practice the girdle nearly always had low spots that allowed the herbicide to drain out.

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STATION NOTE

No. 134
August 1959

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

YELLOW-POPLAR SEED QUALITY VARIES BY SEED TREES, STANDS, AND YEARS

The number of year-old yellow-poplar (*Liriodendron tulipifera* L.) seedlings grown from equal quantities of seed varies as much among individual seed trees within a stand as among stands of different geographic location. Moreover, production will vary from one year to another. This information was obtained from an experiment begun in the Central States in 1952 to study the effects of seed source on growth and development of yellow-poplar plantations.

Seed was collected from five different seed trees in each of six different stands located in Ohio, Indiana, and Illinois. Collections were made in 1952, 1954, and 1955. The number of samaras[1/] collected from each seed tree was determined by counting and weighing representative samples. All seed was stratified over winter and sowed the spring after collection at the State Tree Nursery, Marietta, Ohio.

By using tree percents--the ratio of the number of 1-0 seedlings produced to the number of seeds sown--as a standard for seed quality, interesting differences are apparent (table 1). First, there are wide variations in tree percents among seed trees in each source, as well as among sources. Second, and of great significance, for 4 out of 6 sources one seed tree was superior to the others for each of the 3 years tested, and for the other two sources one seed tree was superior to the others for 2 out of 3 years. Tree percents were consistently low for some seed trees and seed sources, and consistently high for others.

If individual trees from seed collection stands could be classified as to quality of their seed this would obviously boost efficiency of seed collection and increase amount of germination. It is well known that amount of seed produced varies greatly by years; apparently fluctuations in seed quality of yellow-poplar are also common. In stands where seed is collected repeatedly, small-scale tests of individual trees making up the stand will aid in future selection of seed trees. A study of criteria for judging good seed trees, now in progress, may help this important but little-known phase of our reforestation job.

1/ Yellow-poplar "seeds" are samaras with two embryos, one of which is nearly always aborted.

Table 1.--Effects of seed sources, seed trees, and years of seed collection on the quality of yellow-poplar seed

Seed source	Year collected	Tree percent (Ratio of seedling quantity to number of seeds sown)					
		Seed trees					Stands
Marietta	52	1.11	7.64*	0.93	0.88	0.66	1.95
Ohio	54	4.90	5.03*	2.26	3.88	1.55	3.58
	55	2.90	8.60*	1.40	6.90	2.10	3.42
Athens	52	0.21	0.00	0.25*	0.00	0.13	0.12
Ohio (A)	54	.20	1.50	6.76*	2.11	1.06	2.27
	55	.10	.50	2.00*	.90	1.40	.97
Athens	52	0.74*	0.47	0.73	0.68	0.00	0.51
Ohio (B)	54	.91	1.91	1.98	.91	4.45*	2.17
	55	.80	.70	1.10	.30	2.10*	1.12
Zaleski	52	0.35	0.39	0.17	0.47*	0.13	0.28
Ohio	54	2.16	.90	.65	2.62*	.76	1.54
	55	.80	.10	.60	2.00*	.60	.87
Cannelton	52	20.71*	2.74	4.79	7.28	3.47	6.90
Indiana	54	2.52*	1.86	1.44	.59	.55	1.44
	55	6.80*	1.00	1.10	1.00	2.10	2.32
Hardin Co.	52	0.35	0.48	0.23	0.50	3.99*	1.11
Illinois	54	.10	.18	.13	.14	.40*	.21
	55	1.70*	.00	.30	.20	.90	.97

* Best seed tree for each source and collection year.

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Reg'd.

STATION NOTE

No. 133
July 1959

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

FAST-STARTING SPECIES BEST IN SOME IOWA PLANTATIONS

Four fast-growing tree species planted in experimental stand-conversion areas at the Amana Experimental Forest show good potentialities for establishment in spite of severe competition from rank weed growth.

Early in 1955 several species were underplanted in poisoned hardwood stands in an attempt to find methods to improve species composition and stocking of low-quality stands now occupying good forest sites in eastern Iowa. One area was an upland valley, and the other a higher and fairly level upland site. The overstories were killed by applying 2,4,5-T in frills. The following species were then planted at a 6 x 6 spacing:

Upland	Valley
Norway spruce	American basswood
Sherrill hybrid poplar (rooted cutting)	Black walnut
Shimek hybrid poplar (rooted cuttings)	Norway spruce
Eastern cottonwood	European larch
Black cherry	Eastern cottonwood
	Yellow-poplar

Upland Area

After four growing seasons, survival and vigor of Norway spruce and black cherry are poor because these slower growing species have not been able to compete with the exceedingly rank growth of herbaceous vegetation that invaded the area after treatment. The cottonwood and the two hybrid-poplar clones are doing very well. Average survivals of the cottonwood, Shimek and Sherrill hybrids are 80, 70, and 67 percent, respectively. The average total heights of these three species are 12, 20, and 13 feet. One of the Shimek hybrid poplar trees attained a height of more than 26 feet in 4 years.

Much of the early mortality of the hybrid poplars resulted from extensive damage to the lower part of the stems caused by deer rubbing the velvet from their antlers before the rutting season. A repellent-treated rope to discourage this deer activity

was tried without success. In fact, the way in which the ropes were attached to the trees proved harmful. The rope was loosely tied around the stem several feet above ground. During the following year the rapid growth of the hybrids caused a girdling effect on many of the trees before the rope was removed. A number of these girdled trees were snapped off at the point of injury by falling limbs when the dead overstory began breaking up.

Of the presently surviving hybrid poplar, nearly 20 percent show evidence of injury by deer and rope, and a similar number (including cottonwood) have been broken or deformed by fallen overstory material.

Valley Area

Of the species planted along the sides of a small, moderately active drainage, cottonwood and yellow-poplar show the most promise. Basswood, black walnut, Norway spruce, and European larch have generally failed because of severe weed competition, wet soil, and sedimentation in some plots. (Natural seeding of cottonwood in the plots has made it difficult to distinguish planted trees for purposes of examination.)

Yellow-poplar is not native to Iowa, but the Michigan seedlings planted in this valley have made excellent growth and have suffered no apparent climatic injury as yet. Survival on replicated plots ranged from 35 percent to 93 percent, with the poorer survival occurring on lower ground subject to occasional overflow. Growth followed a similar pattern, with average total heights ranging from 7.6 feet on lower areas to 9.5 feet in better drained locations. The tallest yellow-poplar reached 17.5 feet in the 4 years since planting.

Early results from these conversion tests clearly indicate that when upland stands in Iowa are cut or killed before planting, either the species introduced must be capable of fast initial growth, or some supplementary treatment must be made to reduce the typically luxuriant herbaceous vegetation.

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(Maintained in cooperation with
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STATION NOTE

No. 132
June 1959

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

MULCH AROUND NEWLY PLANTED TREES CAN BE DETRIMENTAL

Mulching is generally regarded as helpful to survival and growth of planted trees. However, a recent test in Iowa revealed that under certain conditions mulching may be harmful. In an experimental plantation containing 10 species, twice as many mulched seedlings died the first year as unmulched. Rabbits are blamed for most of the mulched-tree mortality.

The trees were planted in an old cornfield in 1/2-acre plots, one species to a plot. One row of each species was mulched with sawdust and the remaining rows in the plot were not mulched. Approximately 1.5 cubic feet of sawdust was placed in a 3-foot circle around each seedling. During the following growing season, weed development was exceptionally vigorous and dense on the fertile soils of this area, with patches of giant ragweed and wild hemp reaching heights of 5 feet and more. Although the sawdust mulch effectively prevented weed growth on the treated spots, the seedlings were still heavily shaded by a canopy formed from the tall and overtopping vegetation. Survival of most species at the end of 1 year was lower in mulched than unmulched rows:

	Mulched trees (In percent)	Unmulched trees (In percent)
Austrian pine	53	70
Eastern white pine	54	78
European larch	52	26
Norway spruce	4	82
Black walnut	100	100
Cottonwood	80	76
Green ash	4	80
Hybrid poplar	32	70
Red oak	0	59
Yellow-poplar	14	62
All species	40	70

This difference in survival was caused by heavier rabbit injury to mulched trees. Apparently the openings created under the weed cover by mulching were conspicuous and attractive to the many rabbits in the area. It can probably be assumed that any treatment which would result in such openings around the base of small trees would also result in increased rabbit-caused mortality.

Although some species (walnut, cottonwood, and larch) were relatively unharmed by rabbits under either condition, injury to mulched Norway spruce, green ash, red oak, and yellow-poplar was very severe, averaging about 90 percent. For all species combined, nearly half of the mulched seedlings were quickly nipped off, whereas only a fifth of the unmulched trees were so killed. Losses due to competing vegetation, under both conditions, averaged about 10 percent.

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(Maintained in cooperation with
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STATION NOTE

No. 131
June 1959

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

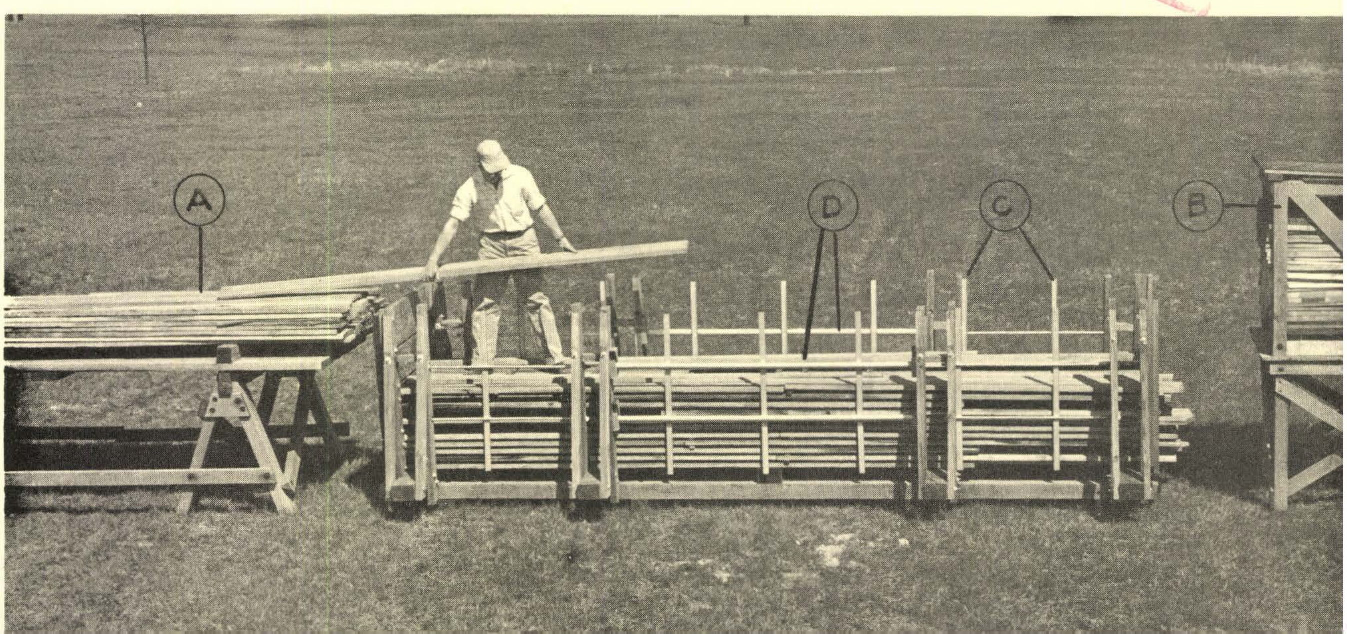
USE A STACKING JIG FOR BETTER LUMBER PACKAGES

A major cause of degrade in air-drying lumber is failure to align the stickers vertically in the packages. Misalignment of stickers often results in warping of the boards. Using a stacking jig for building lumber packages (figs. 1 and 2) assures vertical sticker alignment and uniform package dimensions with no increase in stacking time. The jig makes it easy to stack lumber for both air-drying (fig. 3) and kiln drying, and will pay for itself in a short time by reducing losses from degrade.

One man, standing in the jig, builds the lumber package. He can stack a thousand board feet of 4/4 lumber in 30 minutes if the lumber is fed from a sorting table or a green chain.

For most efficient sorting and stacking, build one jig for each lumber grade separation desired and place beside the sorting table or green chain. The jigs are sturdy enough for years of service but light enough (less than 1,000 pounds) for easy portability by fork truck.

Figure 1.--Partly completed unit package in the stacking jig: (A) Lumber to be stacked, (B) sticker bin, (C) sticker guide channels, and (D) removable gate.



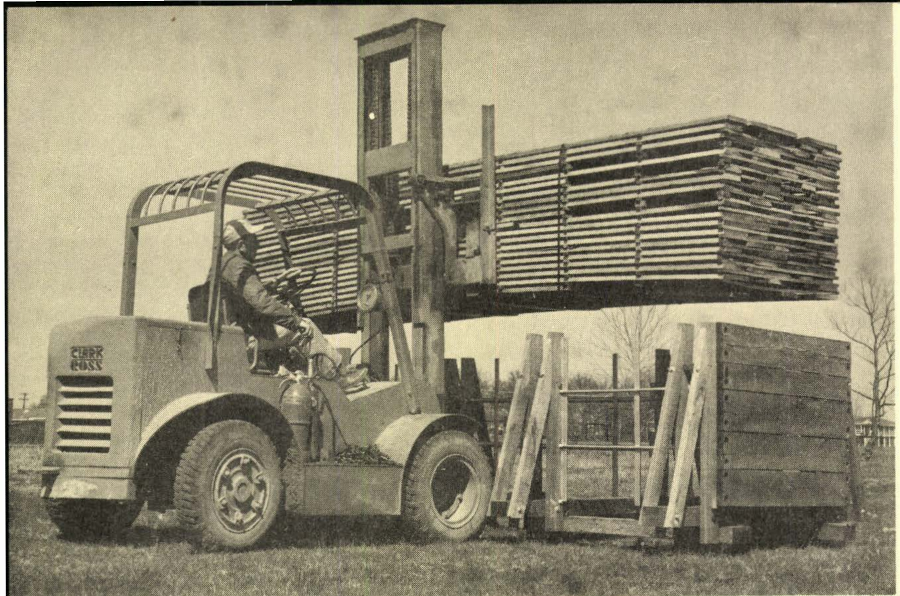


Figure 2.--Complete unit package being lifted from the stacking jig. This package has been made up by "box-piling" random length lumber. Two steel straps around the package facilitate handling. The gate has been removed from the jig to permit entry of the fork truck.

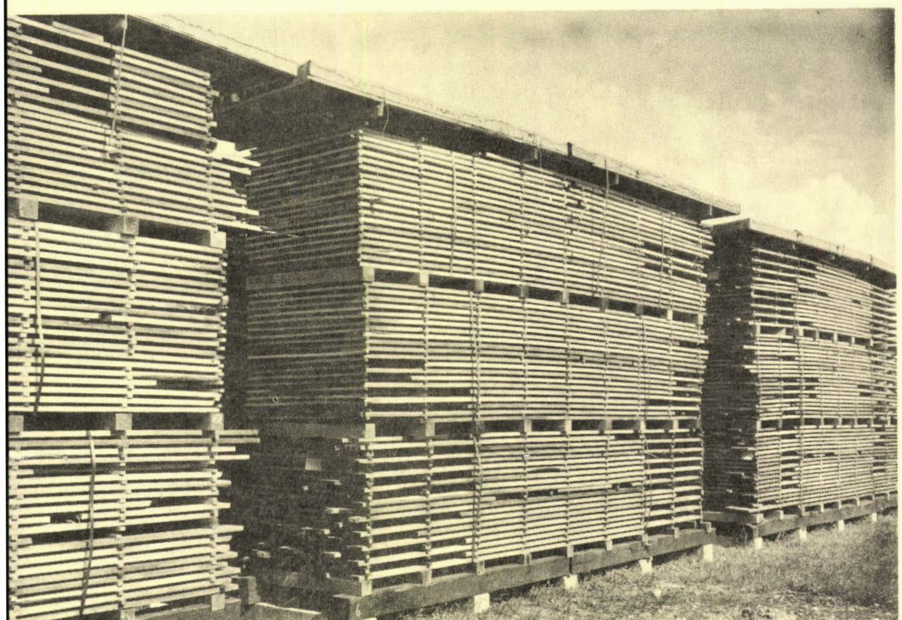


Figure 3.--Unit packages built in the stacking jig. Equal-sized packages facilitate handling, tiering, and subsequent kiln drying. Uniform sticker spacing and good vertical alignment keep all stickers over pile bolsters. Good foundations and pile roofs also reduce degrade during drying.

The jig is designed for building packages 4 feet wide, 3 1/2 feet high, and up to 16 feet long, but the dimensions can be easily modified for building either larger or smaller packages. The jig is made from 100 board feet of rough sawn oak, 32 lineal feet of 1-inch pipe, 16 lineal feet of 1/2-inch pipe, and 49 lineal feet of 1/2- x 1/8- x 1 1/2-inch channel iron. All this costs less than \$50. Two men can build this unit in one day. Complete plans and a bill of materials are attached. Extra copies are available at no charge. [1]

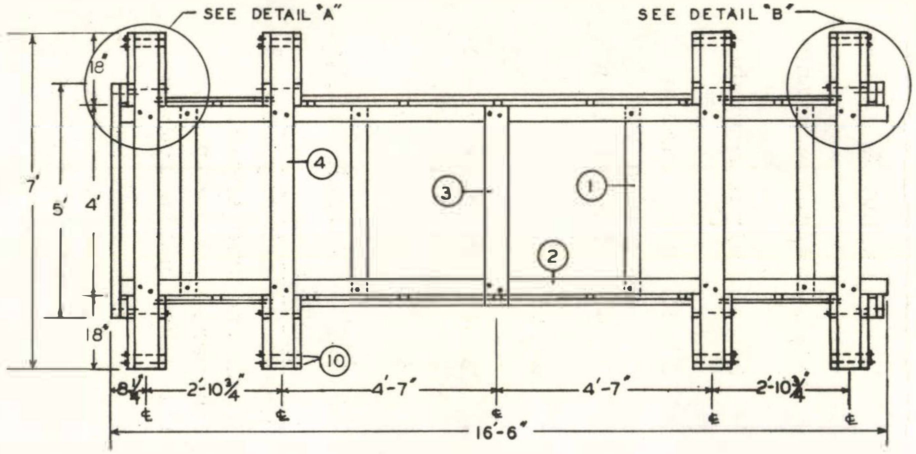
William W. Rice, collaborator
Central States Forest Experiment Station
Carbondale, Illinois
(Maintained in cooperation with
Southern Illinois University)

1/ Plans can be obtained from the Central States Forest Experiment Station, 111 Old Federal Building, Columbus 15, Ohio or the Carbondale Forest Research Center, P. O. Box 760, Carbondale.

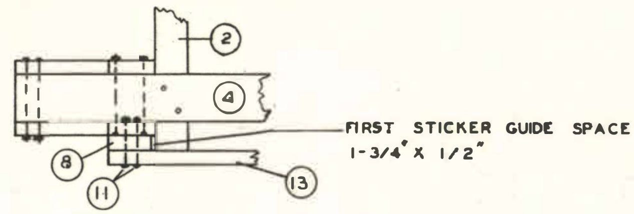
Bill of Materials for 4-foot by 16-foot Lumber Stacking Jig[1/]

Part No.	Name	Quantity	Thickness	Width	Length	Remarks
1	Skid	4	4"	4"	4'-0"	Rough
2	Stringer	2	4"	6"	16'-6"	Rough
3	Cross brace	1	4"	6"	4'-0"	Rough
4	Cross brace	4	4"	6"	7'-0"	Rough
5	Carriage bolt	8	1/2" diameter		11"	W/nut & washer
6	Upright	16	1-3/4"	6"	4'-6"	S2S
7	Angle brace	16	1-3/4"	4"	4'-6"	S2S & angle cut
8	Guide spacer	4	1-3/4"	5-1/2"	3'-8"	S2S
9	Rear guide	2	1-3/4"	6"	3'-8"	S2S
10	Carriage bolt	52	1/2" diameter		10"	W/nut & washer
11	Carriage bolt	30	1/2" diameter		6-1/2"	W/nut & washer
12	Carriage bolt	16	1/2" diameter		8"	W/nut & washer
13	End board	1	1-3/4"	44"	5'-0"	S1S, random width pcs.
14	Sticker guide	14	1/8"x1/2"x1-1/2"		3'-6"	Channel iron
15	Guide support	4	1" inside diameter		8'-2"	Pipe
16	Guide support	8	1/2" diameter		2'-4"	Pipe or steel rod w/nuts
17	Gate bracket	8	1/8"x3"x3"		6"	Angle iron
18	Wood screw	16	No. 12		2-1/2"	Attach bracket

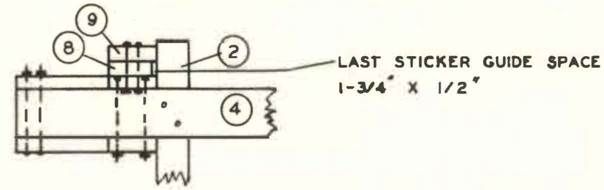
1/ All wood parts to be hardwood (preferably oak), green or air dry, No. 1 Common and poorer in grade. To build jig wider than the one shown, increase length of Parts 1, 3, 4, and 13 by the increase in width of your package beyond 4 feet. The dimensions of all other parts remain the same as shown.



PLAN VIEW
SCALE: 1/2"=1'



DETAIL "A"
SCALE: 1"=1'



DETAIL "B"
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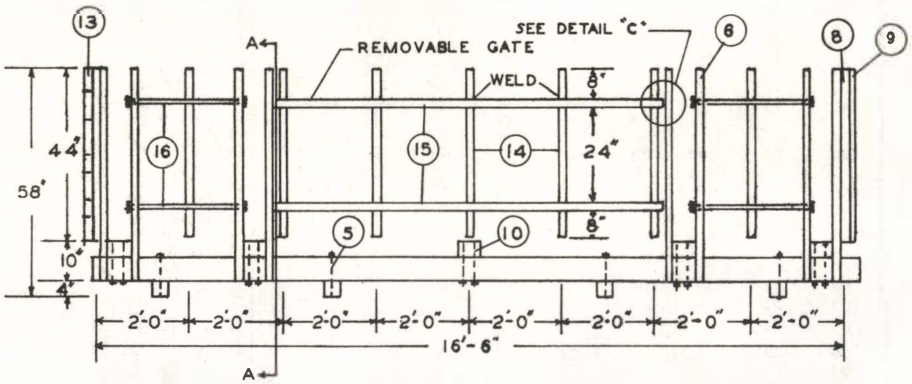
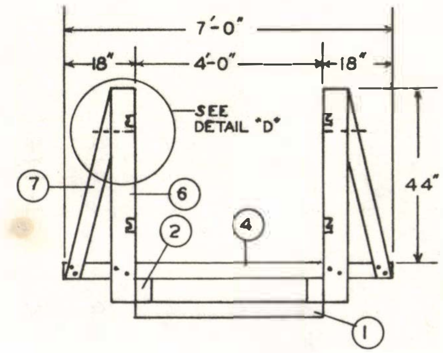
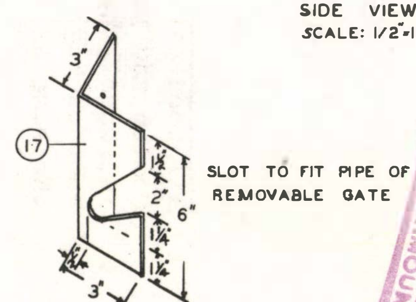


SIDE VIEW
SCALE: 1/2"=1'

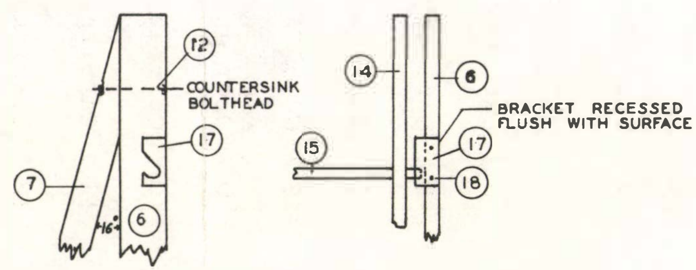


CROSS SECTION AA
SCALE: 1/2"=1'

NOTE: NUMBERS IN CIRCLES
REFER TO BILL OF MATERIALS.



DETAIL "C"
SCALE: 3"=1'



DETAIL "D"
SCALE: 1"=1'

LUMBER STACKING JIG
WOOD PRODUCTS PILOT PLANT
U. S. FOREST SERVICE
SOUTHERN ILLINOIS UNIVERSITY
CARBONDALE, ILLINOIS
W.W. RICE JANUARY 17, 1959

STATION NOTE

No. 130
June 1959

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

PULPWOOD PRODUCTION IN THE CENTRAL STATES - 1958

The steady upward trend in pulpwood production in the Central States continued in 1958 with the harvest of 291,584 standard cords, the largest cut ever recorded. This record crop of pulpwood delivered at the mill had a gross value of $3,597,000 and represented an increase of 43,854 cords or nearly 18 percent over the previous high in 1957.

Ohio retained its position as the leading pulpwood-producing state in the region. Other states maintained their respective 1957 positions despite the lower production reported by Kentucky (table 1).

The increasing importance of hardwoods is evident in the data on pulpwood production. Soft hardwoods, such as basswood, yellow-poplar, aspen, cottonwood, willow, and soft maple, accounted for half the total production, an increase of 23,137 cords or nearly 19 percent over the 1957 production. Hard hardwoods, such as oak, ash, hard maple, and beech, were utilized to produce 43 percent of the total, an increase of 27,004 cords or 27 percent over 1957 production.

Coniferous pulpwood, principally pine, accounted for 6.5 percent of the total production. The decline in coniferous pulpwood production, which began in 1957, has continued. Only 18,947 cords were utilized in 1958, a 25 percent decrease from that recorded in 1957.

Table 1.--1958 Pulpwood production by states

State	Species groups				Percent of total	Change from 1957	Value
	Conifers	Hardwoods		Total			
		Hard	Soft				
	Cords [1]	Cords	Cords	Cords	Percent	Percent	Thousand dollars
Ohio	780	91,315	48,420	140,515	48.2	+20.3	1,624
Illinois	0	7,044	57,190	64,234	22.0	+19.0	836
Kentucky	16,337	12,906	5,878	35,121	12.1	- 2.7	435
Indiana	0	7,095	17,523	24,618	8.4	+46.1	320
Iowa	0	5,636	9,443	15,079	5.2	+ 4.0	205
Missouri	1,830	2,077	8,110	12,017	4.1	+27.2	177
Total	18,947	126,073	146,564	291,584	100.0	+17.7	3,597

1/ Standard cord = 4x4x8 feet of stacked bolts, 0.8 long cord or unit, 4,500 pounds of soft hardwoods, 5,000 pounds of hard hardwoods or conifers.

Table 2.--1958 Pulpwood consumption by states

State	Mills	Species groups: Conifers	Hardwoods: Hard	Hardwoods: Soft	Total	Percent of total	Value
	Number	Cords	Cords	Cords	Cords	Percent	Thousand dollars
Ohio	5	6	97,963	54,770	152,739	52.1	1,772
Illinois	8	8,670	2,300	71,266	82,236	28.0	1,069
Kentucky	0						
Indiana	1)						
Iowa	2) 1/	0	25,133	33,184	58,317	19.9	800
Missouri	1)						
Total	17	8,676	125,396	159,220	293,292	100.0	3,641

1/ Combined to prevent disclosure of individual plant consumption.

Central States pulp and fiber mills utilized 293,292 cords (table 2) valued at $3,641,000. Regional consumption of pulpwood exceeded production by 1,708 cords. Ohio was the leading consumer state utilizing 152,739 cords or 52 percent of the total 1958 consumption.

Pulping capacity increased in the Central States in 1958. Two new mills were added but this increase was partially offset by the conversion of two other mills to the utilization of a raw material other than pulpwood. Pulping capacity of mills using pulpwood now amounts to 1,815 tons per 24-hour day, an increase of nearly 17 percent over that in 1957.

Inter-regional movement of pulpwood amounted to 41,432 cords. Incoming shipments, largely from Wisconsin and Michigan, totaled 21,570 cords. Illinois was the largest consumer of imported pulpwood, accounting for about 90 percent of the total.

Outgoing shipments of pulpwood amounted to 19,862 cords, a decrease of 25 percent from that reported in 1957. Six mills outside the region drew pulpwood from the Central States. Approximately 95 percent of the exported pulpwood was utilized by mills in Tennessee, Georgia, and Mississippi. The remainder went to mills in Pennsylvania and Maryland. Kentucky produced 90 percent of the pulpwood destined for export. Ohio and Missouri also produced pulpwood for export.

The data presented in this report were largely obtained from an annual 100 percent mailing canvass of pulpmills in the Central States region. Data on inter-regional movement of pulpwood were obtained through exchange of information between other Forest Experiment Stations conducting similar surveys. Pulping capacity data were based on a 1958 inquiry conducted independently of the pulpwood production canvass.

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Columbus, Ohio

STATION NOTE

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

No. 129
June 1959

LOBLOLLY SEED FROM MARYLAND BEST OF SIX SOURCES TESTED IN SOUTHERN ILLINOIS

Geographical seed source affects survival and growth of loblolly pine in southern Illinois, but which is best for this area? Ten years after planting, trees from a Maryland seed source grew better than trees from five other seed sources tested.

Seedlings from Arkansas, Mississippi, North Carolina, South Carolina, Maryland, and Virginia seed sources were grown in the same nursery bed in southern Illinois and planted on similar upland old-field sites. All brush more than 2 feet high was cut before planting.

Plantings of trees from the 6 sources were made in 5 locations in southern Illinois. At each location one 0.179-acre plot was planted with trees from each source. One-third of the 216 trees in each plot were measured to get heights, diameters, and survival rate.

Many trees from the three southernmost sources were frost killed the second winter after planting;[1] however, frost had little effect on survival of trees from Maryland, Virginia, and Arkansas seed sources (table 1).

After 10 years trees from the Maryland source were tallest and largest on all plots. In portions of some plots competition from hardwood brush occurred, but in the Maryland and Virginia seed-source plots the fast growth and good survival of the trees tended to suppress this competition.

1/ Minckler, Leon S. Loblolly pine seed source and hybrid tests in southern Illinois. Cent. States Forest Expt. Sta. Tech. Paper 128, 8 pp., illus. 1952.

Table 1.--Tenth-year survival and growth of loblolly pine from six seed sources

Seed source	Survival (Trees per acre)		Mean diameters	Mean heights	Basal area (per acre)
	Number	Percent	Inches	Feet	Square feet
Worcester County Maryland	1,127	93.1	4.1	25	106
Matthews County Virginia	1,099	90.8	3.9	23	94
Southwestern Arkansas	1,112	91.9	3.7	22	90
Mississippi	851	70.3	3.9	22	79
Pender County North Carolina	945	78.1	3.5	21	70
South Carolina	930	76.9	3.6	21	69

The combination of survival and average diameter for trees of the different seed sources can best be expressed in terms of basal area of the stands. Stands from the deep south seed sources not only were shorter but had only 65 to 75 percent as much basal area as the Maryland stands. It seems apparent that loblolly pine from deep south seed sources should not be planted in southern Illinois.

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Central States Forest Experiment Station
Carbondale, Illinois
(Maintained in cooperation with
Southern Illinois University)

STATION NOTE
No. 128
June 1959

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

BUTT-LOG TREE GRADING WORKS IN OHIO

There is no short-cut system for grading hardwood trees that has been tested and proved throughout the Central Hardwood Region. In 1957 a butt-log system for grading and evaluating black oak (Quercus velutina Lam.) trees was developed and tested in southern Illinois.1/ Although the system, which is based on grading the best 10-foot section of the butt 16-foot log, is suitable for southern Illinois trees, we did not know if it could be used elsewhere. As a first step to find this out, we tested this "butt-log" system in southeastern Ohio and found that we could accurately estimate the dollar value of a group of black oak trees in that area.

Forty-four black oak trees were studied on the Vinton Furnace Experimental Forest in Vinton County, Ohio. These trees, containing a total volume of 12,780 board feet (International 1/4-inch scale), were graded using the butt-log system. The trees were then felled and bucked, and every visible defect on the merchantable bole of the tree was recorded on a diagram. The "trees" were "rebucked" on the diagrams to recover logs of maximum quality and volume.2/ Three cash values were computed for each tree, as follows:

1. Logs resulting from "rebucking" the "trees" on the diagrams were graded according to the system described in Forest Products Laboratory Report D-1737. International 1/4-inch log-rule volumes were used, and value was computed on the basis of the current market price of 4/4-inch, plain sawn, No. 1 Common red oak lumber, which was $90 per thousand board feet. This was considered the check or "actual" tree value.

1/ Herrick, David E. and Jackson, Willard L. The butt log tells the story. Cent. States Forest Expt. Sta. Sta. Note 102, 2 pp. 1957.

2/ U. S. Forest Service. Hardwood log grades for standard lumber; proposals and results. Forest Prod. Lab. Rpt. D-1737, 15 pp., illus. 1949.

2. Each standing tree was graded according to the butt-log system. Individual tree volume was obtained by summing the log volumes from each "rebucked" diagram. Tree value was computed using this volume, tree quality index from the butt-log system, and the price of lumber as above.

3. Each standing tree was graded according to the butt-log system. Tree volume was estimated from Mesavage and Girard Form Factor Volume Tables (form factor 78). Tree value was computed using estimated volume, and tree quality index and price as in No. 2.

Differences between the "actual" value of Ohio trees and the "actual" value of Illinois trees, of the same d.b.h.-height-quality classes, were not significant. Consequently, it appeared that the butt-log grading system developed for Illinois trees should apply to trees in southeastern Ohio. This inference was borne out by comparing the butt-log estimates with the "actual" values. Using the butt-log system and scaled volumes, the estimated value of the 44 Ohio trees differed from "actual" total value by only 0.6 percent. When the butt-log system and form factor 78 volumes were used, the estimate of total dollar value was only 3.4 percent in error.

Further tests are needed to find if this system can be used throughout the Hardwood Region.

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Athens, Ohio
(Maintained in cooperation with
Ohio University)

STATION NOTE

No. 127
April 1959

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

GROWTH OF UPLAND HARDWOODS IN SOUTHERN INDIANA

Annual growth rate in a well stocked, hardwood sawtimber stand in southern Indiana has averaged 227 to 246 board-feet per acre for the past 11 years. Although growth has not been outstanding, the potential for such a stand appears to be very good.

This information comes from forty 1/5-acre plots established on a tract of sawtimber in the fall of 1946.[1] The plots were in uneven-aged stands of oak-hickory and mixed hardwood (sugar maple, ash, beech, hickory, elm, and others) (table 1). The oak-hickory stand averaged 7,550 board-feet gross and the mixed hardwood 7,780 board-feet gross per acre. Both stands contained 70 square feet basal area in trees more than 9.5 inches d.b.h. The tract lies on typical sandstone-derived soils in the unglaciated region of southern Indiana. The oak-hickory type is on the upper slopes and ridges and the mixed hardwood type on the lower slopes (fig. 1).

Ingrowth accounted for 42 board-feet of the total annual production of 246 board-feet in the oak-hickory type and 47 board-feet of total annual production of 227 board-feet in the mixed hardwood stand.

Even though the mixed hardwoods are on a better site, total volume production was less than that for the oak-hickory type because of numerous large, overmature beech in the mixed hardwood type. These trees occupied a lot of space but grew slowly. And yellow-poplar, a fast-growing species normally common to such stands, was poorly represented in the type.

Figure 1.--Mixed hardwood stand on lower north slope.

Table 1.--Stand tables for 1946 and 1958

(In number of trees per acre)

D.b.h. (inches)	Oak-hickory		Mixed hardwood	
	1946	1958	1946	1958
10 - 14	40	36	31	32
15 - 19	16	19	11	16
20 +	5	10	10	12
Total	61	65	52	60

The importance of species composition to over-all growth is shown by an analysis of diameter growth. In the oak-hickory type red oak grew best, with an average diameter increase of 2.5 inches in the 11-year period. White oak averaged 1.7 inches, while hickory and sugar maple grew 1.2 inches in diameter. In the mixed hardwood stand ash grew best, averaging 1.9 inches in 11 years; sugar maple grew 1.5 inches; hickory 1.4 inches; and beech only 1.2 inches. Both hickory and sugar maple grew better in the mixed hardwood stand even though stocking in both types was nearly identical, showing that growth potential is better on the mixed hardwood site.

In the oak-hickory type the heavy stocking has favored the development of sugar maple and hickory in the understory. Intensive understory control may be needed to counter this trend when a harvest cut is made. In the mixed hardwood type sugar maple dominates the understory. Ash is present in adequate amounts but yellow-poplar and red oak are nearly absent. Although sugar maple may be an acceptable species on this site, yellow-poplar, ash, and red oak would be more desirable.

The relatively low diameter growth rates and heavy mortality are indications that a cut is needed. A heavy improvement cut to reduce stocking and improve composition would undoubtedly result in excellent growth and favor development of better species.

LaMont G. Engle, forester
Bedford Forest Research Center
Bedford, Indiana

1/ Installed by C. B. Stott, U. S. Forest Service.

STATION NOTE

No. 126
April 1959

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

SITE INDEX CURVES FOR EASTERN COTTONWOOD

Site index curves have not been available for eastern cottonwood. To fill this need we measured trees in Illinois, Indiana, Missouri, and Kentucky.

Curves were developed from data collected on 172 trees located in 59 bottomland areas, 3 upland areas, and 3 strip-mined areas. Total age for each tree was obtained by adding 2 years to the breast-height "age." Although the ages ranged from 11 to 53 years, most of the trees were between 11 and 32 years old. Trees ranged from 38 to 131 feet in height.

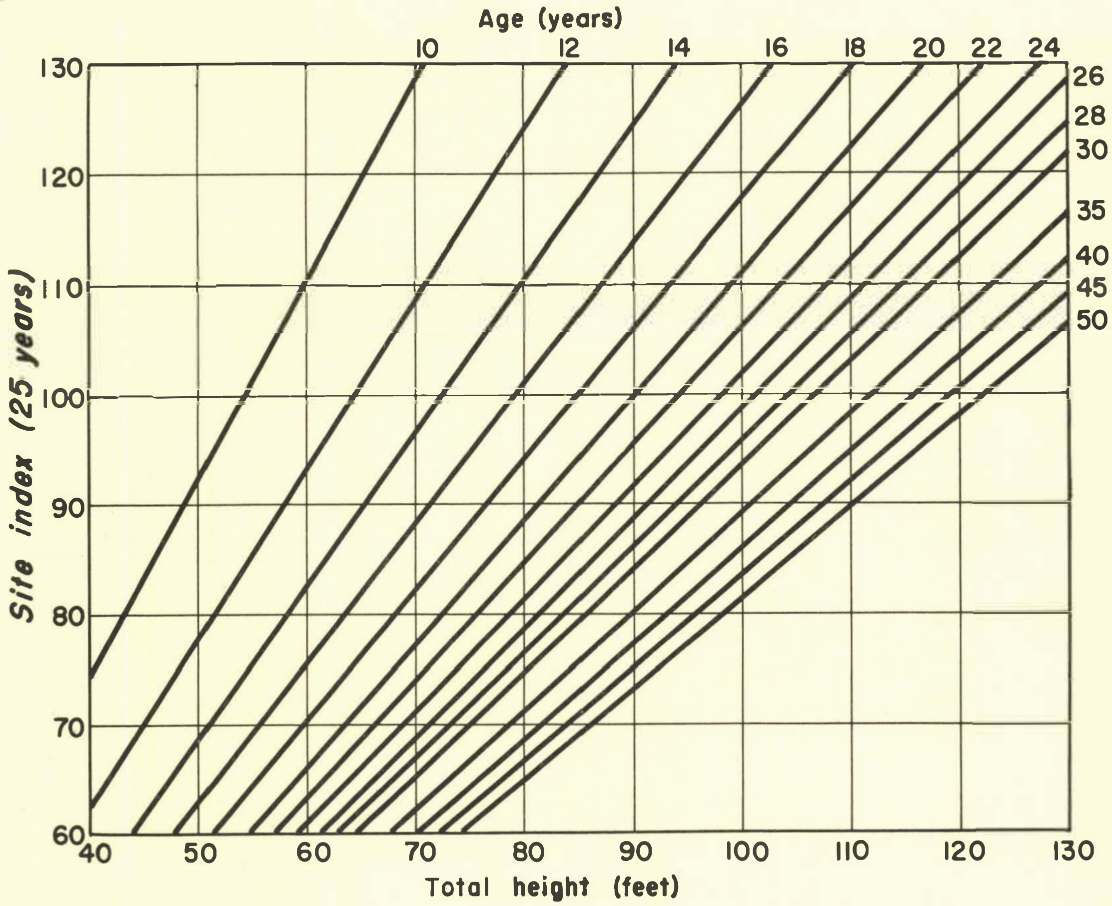
From present age and height, the curves show the heights that trees attain at 25 years. Straight-line "curves" were used because they are easier to read.

Average site index was 98 for bottomland areas, and 78 for upland and spoil-bank areas. Williamson[1] measured heights of eastern cottonwood trees in the Mississippi Valley. The height-age relationship of his data was similar to ours except that for a given age his trees were taller. Thus, we believe these site index curves (back page) may be useful wherever cottonwood grows.

David J. Neebe, forester
Stephen G. Boyce, forester
Carbondale Forest Research Center
(Maintained in cooperation with
Southern Illinois University)
Carbondale, Illinois

1/ Williamson, A. W. Cottonwood in the Mississippi Valley. U. S. Dept. Agr. Bul. No. 24, 62 pp. 1913.

SITE INDEX CURVES FOR EASTERN COTTONWOOD



To use the curves:

1. Find present tree height on the bottom line.

2. Follow up the vertical line for this height until it intersects the diagonal line for present age.

3. Follow left on the horizontal line and read site index.

STATION NOTE

No. 125
December 1958

CENTRAL STATES FOREST EXPERIMENT STATION
COLUMBUS, OHIO W. G. McGINNIES, DIRECTOR
U. S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

TEN-YEAR TIMBER-CUTTING CYCLE PROVIDES A CONTINUING SUPPLY OF FORAGE

Partially cut forested areas...

Harvesting merchantable trees and killing culls in Missouri forests produce small openings in which deer and cattle forage is increased.[1/] The value of this forage increase depends in part on whether it lasts until the next cutting. To determine the duration of such forage increases, we measured vegetation on 1-square foot plots around stumps of large trees in a typical white oak stand in the southern Ozarks 3, 6, and 9 years after a timber sale, and compared it with vegetation around uncut trees of similar size. Openings around stumps were still visible after 9 years, but growth of the crowns of saplings and surrounding large trees had decreased their size.

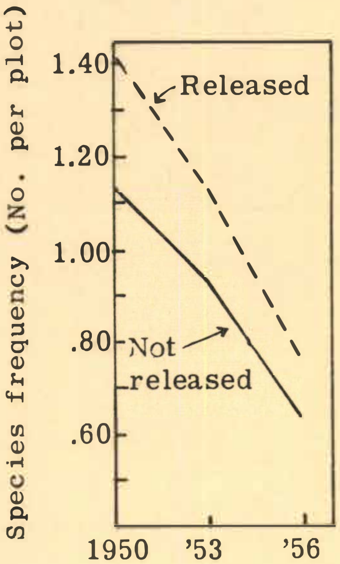
produced more forage...

By 1950, three years after the cut was made, all low-growing vegetation except tree reproduction had increased strikingly as compared with vegetation on similar uncut areas. During the next 3 years, forbs and grasses declined in frequency (a measure of abundance), tree reproduction remained steady, and browse continued to increase on both released and unreleased areas. During the last 3 years, forbs, grasses, and browse decreased, but tree reproduction increased. Whereas grasses and forbs dominated the understory vegetation in 1950, tree reproduction and browse were dominant in 1956.

for at least 9 years.

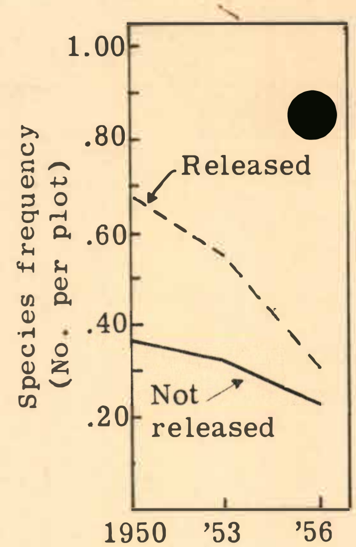
Although the greatest forage production in these new openings in forest stands occurred within the first 3 to 6 years after cutting, significant benefits lasted 9 years. Thus, under the conditions sampled, the 10-year cutting cycle used on managed forests in Missouri Ozarks creates new openings while the older ones are still productive and provides a continuing supply of forage, particularly for deer.

For details of the 3rd-to-9th-year trends, please turn to the back of this sheet.



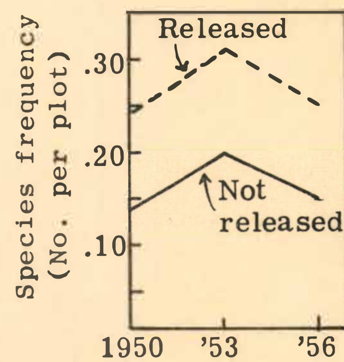
Forbs

Forbs and grasses decreased in frequency on both areas throughout the last 6 years. Drouth, as well as tree competition, probably accounted for the decline. Both forbs and grasses remained much more numerous on released than unreleased areas through 1956, but the effects of release were much diminished, particularly for grasses, after 9 years.

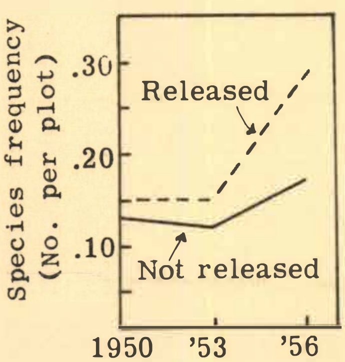


Grasses

Palatable browse (shrubs, vines, and a few small palatable trees) was much more abundant on released areas at all three measurements. In 1956, nine years after timber cutting, this valuable type of deer forage was still about 1.7 times more numerous on released than unreleased areas.



Browse



Tree Reproduction

Tree reproduction (trees less than 10 feet tall) remained about the same from 1950 to 1953, but increased sharply, particularly on released areas, from 1953 to 1956. This increase, plus the growth of saplings, and a 4-year dry period probably accounted for the decline in other classes of vegetation.

Thomas S. Baskett, Missouri Cooperative Wildlife Research Unit, Columbia, Missouri

Robert L. Dunkeson, Missouri Conservation Commission, Columbia, Missouri

S. Clark Martin, formerly Columbia Forest Research Center, CSFES (maintained in cooperation with the University of Missouri) Columbia, Missouri

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1/ Martin, S. C., Dunkeson, R. L., and Baskett, T. S. Timber harvests help offset forage decline in Missouri's managed forests. Jour. Forestry 53: 513-516, illus. 1955.

Baskett, T. S., Dunkeson, R. L., and Martin, S. C. Responses of forage to timber stand improvement in the Missouri Ozarks. Jour. Wildlife Mangt. 21: 121-126, illus. 1957.

No. 124
November 1958

STATION NOTE

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

Pulpwood Prices and Measures in the Central States

The pulpwood industry in the Central States is growing. Since 1952 the amount of pulpwood harvested has increased 80 percent; since 1954 the number of wood-processing mills have increased 40 percent. Moreover, mills located outside the Central States, but purchasing pulpwood from the Central States, have increased from 4 to 10 since 1954. This growth of the pulpwood industry provides markets for wood that was formerly not salable. Hence more people need information about the prices and measures used in the pulpwood market.

In 1958 a study was made to obtain information on the kind of wood being purchased, the units of measure used in purchasing pulpwood in the Central States, and the prices paid for pulpwood in 1957.

Wood-using pulpmills vary in the kinds of wood used. Central States mills are now buying round, peeled and unpeeled wood, sawmill slabs, veneer cores, wood chips, and other mill residues. Some mills use only hard-hardwoods, or soft-hardwoods, or conifers; some use all three. Conifers make up slightly more than 10 percent of all pulpwood produced in the Central States. Currently about 90 percent of all wood used by Central States mills is unpeeled roundwood from 4 to 14 inches in diameter at the small end.

In the region as a whole more pulpwood is purchased by the unit or long cord[1] than by any other unit of measure (table 1). However, for individual states, this is only true for Ohio. In Iowa, Illinois, Indiana, and Missouri more than 60 percent of the total volume was purchased by the ton. In Kentucky, the standard cord[2] is the most common unit used.

1/ Long cord or unit (4'x5'x8') = 160 cu. ft.
2/ Standard cord (4'x4'x8') = 128 cu. ft.

Table 1.--Pulpwood purchased by units
(In percent)

State	Ton	Long cord	Standard cord	Total
Illinois	62	24	14	100
Indiana	62	22	16	100
Iowa	67	0	33	100
Kentucky	0	36	64	100
Missouri	66	25	9	100
Ohio	11	65	24	100
All Central States	30	43	27	100

The prices paid for pulpwood in the Central States vary with the mill, condition of wood (unpeeled or peeled, green or dry, slabwood, roundwood, or chips), and the delivery point. Shown below are prices paid at the mill by 18 pulp and fiber mills that purchased round pulpwood in the Central States in 1957.

Unit of Measure (unpeeled)	Price Range (dollars)
Ton	
Hard-hardwoods	5.20 - 7.00
Soft-hardwoods	5.20 - 6.75
Standard cord	
All hardwoods	11.00 - 18.00
Long cord	
Soft-hardwoods	11.50 - 16.50

Orris D. McCauley, research forester
Columbus, Ohio

Save STATION NOTE

No. 123
November 1958

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

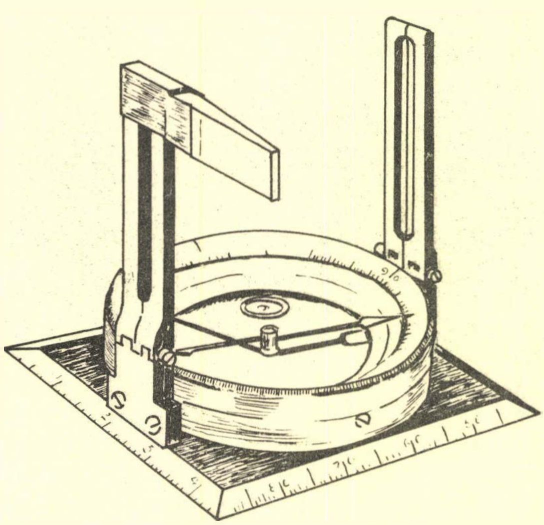
USE THE "WEDGE" WITH A STAFF COMPASS

Development of the Bitterlick system of plotless cruising introduced new tools to the forester. One of the simplest is the glass prism or "wedge" as it is called because of its shape.

The wedge is a reasonably accurate tool for estimating the basal area of timber if certain precautions are taken when using it. Probably the two most important rules are: (1) Keep the prism oriented over plot center and (2) keep the prism at a right angle to the line of sight.

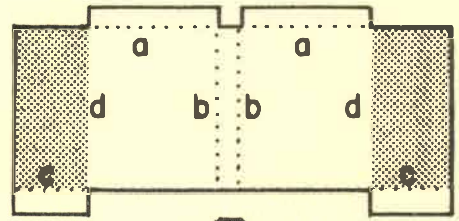
Both of these precautions are difficult to comply with when, as is customary, the cruiser stands at plot center, holds the wedge between his fingers and sights through it at individual trees. Because of natural body sway and movement, "plot center" may be an area 1 foot or more in diameter and the angle to the line of sight may vary.

If you use a staff compass these difficulties can be overcome by mounting the wedge on the rear sighting standard of the compass (below). With the jacob staff placed at plot center, the wedge will remain close to plot center. And the wedge is at right angles to the line of sight as long as the compass is level. Also, the wedge is held steadily so that the view of each tree is clear. Finally, mounting the wedge on the compass in this way facilitates correcting for slope. Simply measure the slope angle with an abney level and set it. Then place the abney across the compass at a right angle to the line of sight and tilt the compass to the right or left until the bubble on the abney shows level. 1/

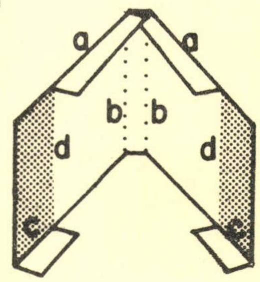


1/ For more on correcting for slope see "Application of the Variable Plot Method of Sampling Forest Stands," by John F. Bell and Lucien B. Alexander, Oregon State Board of Forestry, Research Note No. 30.

You can make a convenient holder from a piece of light metal (tin will do) with a pair of metal shears, soldering iron, and solder.



Cut the metal to fit the pattern, then fold on the dotted lines to form right angles.



Fold at positions "a" and "b" first and shape to fit the sighting standard of the compass. Solder the metal lapped at "a".

The base of the wedge is likely to be a different thickness than the sighting standard of the compass. After the wedge holder has been shaped to fit the compass and fixed in position with solder, fold at "c" and shape the shaded portion of the holder to fit the base of the wedge. This may require spreading or bulging the metal outward along line "d". When the metal has been shaped to fit the wedge snugly and with a little tension, solder the metal lapped at "c" in position.

This completes the wedge holder unless you wish to strengthen it by soldering a divider plate at position "d" between the wedge and the sighting standard. In use, the wedge holder should support the wedge by friction or tension.

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STATION NOTE

No. 122
November 1958

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

CONIFERS VS. HARDWOODS ON OLD-FIELD SITES

Three pines (loblolly, shortleaf, and white), redcedar, and three hardwood species (yellow-poplar, white ash, and black walnut) planted on two upland old-field sites in southern Illinois show marked differences in height growth after 11 years. Survival is good for the conifers, but poor for all hardwood species.

The sites are similar in terms of soil and past use, but different in topography and amount of erosion. Both have yellow silt-loam soil of loessal origin and had not been cultivated for 10 to 12 years before planting.

The better site is a nearly level, broad ridgetop, only slightly eroded and covered with broomsedge. Topsoil is approximately 7 inches deep and the subsoil about 16 inches. Below this is undifferentiated loess. Organic material has been deposited to a depth of about 1/2 inch.

The poorer site is a severely eroded, northeast-facing, upland slope with a light cover of annual weeds and grasses. All of the topsoil and part of the subsoil had been eroded from the middle portion of the plots while the upper and lower slope portions of the plots have about 5 inches of topsoil and 14 inches of subsoil.

Two hundred trees of each species were planted on each area at a 6 x 6 foot spacing. Black walnut was seeded with two nuts per spot and white pine was 2-2 planting stock. Planting stock for all other species was 1-0 seedlings. The yellow-poplar came from a southern Indiana seed source and the redcedar from Missouri. All other species were grown in Illinois nurseries, but the seed source is unknown.

The average 11-year survival for the conifers is 84 percent on the better site and 89 percent on the poorer site. For the hardwoods, average survival is 72 percent on the better site and only 47 percent on the poorer site. Yellow-poplar on the better site is the only hardwood that shows any promise; however, many of these trees have poor form.

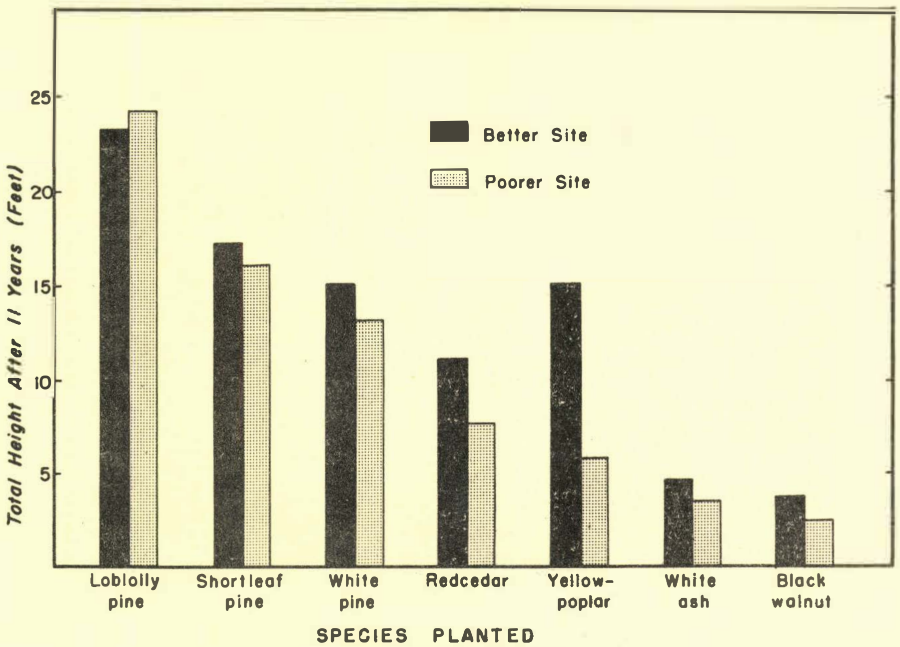

Figure 1.--Heights of trees 11 years after planting.

After 11 years loblolly pine is tallest, shortleaf pine is next, and white pine third (fig. 1). This is the same ranking that prevailed in these stands 6 years ago.[1] The growth rate of eastern white pine has increased during the last few years and many trees have grown 2 to 3 feet in height each year. Redcedar appears to be growing vigorously but more slowly than the pines. The hardwoods, however, are failing. Many of them have survived on the better site, but they are much shorter than the pines. Their form is generally poor and their survival is poor compared with the conifers.

On the poorer site the amount of topsoil left greatly affected height growth of two hardwoods. On the severely eroded portions yellow-poplar and ash average about 2.6 feet in height, but where there is 5 inches of topsoil the average height is 7.9 feet for yellow-poplar and 4.8 feet for ash. The pines and redcedar on the other hand grew about the same throughout the plots.

It is apparent that the hardwoods used in this planting test should not be planted on these or similar old-field sites. All of the conifers tested appear to be adapted to these sites.

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1/ Minckler, Leon S. Comparative success of conifers and hardwoods planted on two old-field sites in southern Illinois. Cent. States Forest Expt. Sta. Note 67, 2 pp., illus. 1952.

STATION NOTE No. 121
November 1958

INTERMOUNTAIN STATION
Central Reference File
No. 0.73

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

CUBIC FOOT VOLUME TABLES FOR PLANTED SHORTLEAF PINE

Many shortleaf pine stands in the Central States are approaching the age when their thinnings will be marketable. Plantation owners and managers will soon need volume tables in order to accurately estimate growth and yield and to regulate growing stock. As a first step toward meeting this need, we have developed volume tables for shortleaf pine plantations in southern Indiana.

An arithmetic equation of the combined variable type was used to construct the volume tables. The equation we used was

$$\text{Volume} = a + bd^2H$$

where

a and b are regression coefficients and d^2H is the combined variable which is diameter at breast height squared times total tree height.

Data were taken from 180 trees cut in experimental thinnings of 17-year-old and 21-year-old plantations. Estimating equations were calculated for each stand and the equations were nearly identical. So we combined data from the two stands. The volume equations and their accuracy are given at the bottom of the tables. Average d.b.h. of the trees used was 5.7 inches and ranged from 3.6 to 9.0 inches. Total tree height averaged 36 feet and ranged from 28 to 44 feet.

Volumes given in tables 1 and 2 do not include bark. According to a formula developed by Chamberlain and Meyer[1] bark volume for the trees used was 22 percent. Table values times 1.28 equals volume including bark.

Data from the thinning study showed that there were 75 cubic feet of wood in a standard cord. To convert merchantable cubic feet of peeled wood to cords of unpeeled wood merely divide by 75. This factor applies to straight, uniform bolts tightly stacked.

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Robert D. Williams, forester
Bedford Field Office
Bedford, Indiana

1/ Chamberlain, E. B. and Meyer, H. A. Bark volume in cordwood. Tappi 33: 554-555.

Table 1.--Total peeled cubic foot volume[1] for planted shortleaf pine

(Including stump and top)

D.b.h. (inches)	Total height (feet)								
	10	15	20	25	30	35	40	45	50
1	0.25	0.26							
2	.32	.36	0.41	0.45					
3		.52	.62	.72	0.82				
4			.93	1.10	1.28	1.46	1.63		
5				1.60	1.87	2.14	2.42	2.69	
6				2.20	2.59	2.99	3.38	3.78	4.17
7					3.45	3.98	4.52	5.06	5.59
8					4.43	5.13	5.83	6.53	7.23
9					5.55	6.44	7.32	8.21	9.10
10					6.80	7.89	8.99	10.08	11.18

1/ Estimating equation is: Volume = $0.23 + 0.002189\ d^2H$. Standard error of the estimate (Sy.) is $\pm$ 0.28 cubic feet. Correlation coefficient (r) is 0.97.

Table 2.--Merchantable peeled cubic foot volume[1] for planted shortleaf pine

(To a 3-inch top, inside bark; 2-inch stump excluded)

D.b.h. (inches)	Total height (feet)						
	20	25	30	35	40	45	50
4	0.49	0.67	0.85	1.03	1.21		
5	.90	1.18	1.45	1.73	2.01	2.29	
6		1.79	2.19	2.59	3.00	3.40	3.80
7		2.52	3.06	3.61	4.16	4.70	5.25
8		3.35	4.07	4.78	5.50	6.21	6.93
9			5.21	6.11	7.01	7.92	8.82
10			6.48	7.60	8.71	9.83	10.94

1/ Estimating equation is: Volume = $-0.22 + 0.002233\ d^2H$. Standard error of the estimate (Sy.) is $\pm$ 0.30 cubic feet. Correlation coefficient (r) is 0.97.

STATION NOTE

INTERMOUNTAIN STATION
Central Reference File
No. 0.73

No. 120
November 1958 A. L.

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

1957 PULPWOOD HARVEST--CENTRAL STATES

The six Central States produced nearly a quarter of a million standard cords of pulpwood in 1957. Almost half of this came from Ohio (table 1). The gross value of all this wood amounted to more than 3 million dollars.

Table 1.--1957 Pulpwood harvested by states
(In standard cords[1/])

State	Conifers	Hardwoods		All species		
		Hard	Soft	Volume		Value
	Cords	Cords	Cords	Cords	Percent	Thousand dollars
Ohio	773	81,838	34,230	116,841	47	1,517
Illinois	594	2,850	50,550	53,994	22	751
Kentucky	22,282	6,734	7,078	36,094	14	474
Indiana	--	2,542	14,310	16,852	7	229
Iowa	--	4,018	10,487	14,505	6	193
Missouri	1,585	1,087	6,772	9,444	4	121
Total	25,234	99,069	123,427	247,730	100	3,285

1/ 1 standard cord = 4x4x8 feet of stacked bolts, 0.8 long cord or unit, 4,500 pounds of soft-hardwoods, 5,000 pounds of hard-hardwoods or conifers.

Twenty-five pulp and fiber mills reported using pulpwood produced in the region, an increase of 21 percent over 1956. However, seven of the mills each obtained less than 1,000 cords from within the Central States. Approximately 11 percent (26,400 cords) of pulpwood harvested in the Central States was shipped to mills located in Tennessee, Maryland, Virginia, Mississippi, Pennsylvania, and Wisconsin. Practically no pulpwood was shipped to the Central States from other states.

Soft-hardwoods (including basswood, yellow-poplar, aspen, cottonwood, willow, and soft maple) made up 50 percent of the total pulpwood production in 1957; hard-hardwoods (including oaks, ash, hard maple, and beech) accounted for 40 percent; the remaining 10 percent was made up of coniferous species (principally pine).

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STATION NOTE

No. 119
October 1958

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

GROUND TREATMENT AND SEED SUPPLY INFLUENCE ESTABLISHMENT OF SHORTLEAF PINE REPRODUCTION

Preliminary results of a pine reproduction study in Kentucky indicate that the method of ground treatment and the number of seed trees per acre affect the number of shortleaf pine seedlings present 1 year after seedfall.

Plots were located in recently logged, mature oak-pine stands on ridges of the Cumberland Plateau. This ridgetop soil was a Hartsells sandy loam and generally deep but underlain by sandstone bedrock. Ground treatments consisted of scarification by (1) logging only, used as check, (2) disking after logging, and (3) bulldozing after logging. The treatments were intended to expose mineral soil to serve as seedbeds and, in addition, destroy or reduce a dense understory of small hardwood trees and shrubs that, if left, would shade out young pine seedlings. Half of the study area contained 15 pine seed trees per acre and the other half only 6. Each treatment was replicated four times for each seed-tree density.

The logging treatment, typical for this area, exposed little mineral soil except along skidways, and left most of the hardwood understory standing. Disking with a tractor-drawn, heavy, four-disk harrow, exposed a great deal more mineral soil than logging and cut up many of the roots and stems of the hardwood understory. Bulldozing sheared off or entirely up-rooted most of the hardwood understory and exposed more mineral soil and left the ground surface with fewer roots and stems than did disking (fig. 1).

Three times as many pine seedlings occurred 1 year after treatment on bulldozed plots as on check plots (table 1). Disking also resulted in a significant increase in number of seedlings, although somewhat less than bulldozing.

Figure 1.--A typical plot immediately after logging and bulldozing.

Table 1.--Average pine seedfall and number of seedlings by ground treatment and number of seed trees

Treatment	6 Seed trees per acre			15 Seed trees per acre		
	Seedfall per acre 1956	Seedlings per acre Nov. 1957	Seeds per seedling	Seedfall per acre 1956	Seedlings per acre Nov. 1957	Seeds per seedling
	Number	Number	Number	Number	Number	Number
Bulldozed	122,000	7,500	16	151,000	9,900	15
Disked	107,000	4,100	26	177,000	8,100	22
Check	116,000	1,600	72	201,000	2,900	69

As might be expected more seedlings were established under heavy seed-tree stocking than under light stocking regardless of treatment. Approximately 16 seeds fell for each surviving seedling 1 year after seedfall on the bulldozed plots, 24 seeds on the disked plots, and 70 seeds on the check. Seedfall was estimated from the number of seed collected from 48 mechanically spaced seed traps for each of the seed-tree densities. Seedling mortality between July and November amounted to 18 percent on the bulldozed plots, 8 percent on the disked, and 21 percent on the check, but still there was enough reproduction for adequate stocking.

Past experience on the Cumberland Plateau indicates that disking not only increases the number of pine seedlings but also the number of hardwood sprouts.[1] Unless additional steps are taken these sprouts generally overtop and shade out most of the pine in 4 or 5 years. On the present disked plots, 1 year after treatment, there were already some 10,400 sprouts of undesirable hardwoods per acre, 6,100 sprouts on the bulldozed plots, and 7,900 sprouts on the check plots. Sprouts were largest on the check plots and smallest on the bulldozed plots.

Preliminary results of this study reveal that with an adequate seed source bulldozing or disking will create conditions for obtaining a satisfactory initial stocking of pine reproduction in oak-pine stands. However, further observations are necessary to determine whether any treatment used is adequate to insure the pine seedlings against overtopping by the fast-growing hardwood sprouts in the future.

Martin E. Dale, forester

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(Maintained in cooperation with
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1/ Sander, Ivan L. Disking increases shortleaf pine reproduction, but... Cent. States Forest Expt. Sta. Note 111, 2 pp., illus. 1957.

STATION NOTE

No. 118
August 1958

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE — FOREST SERVICE

UPLAND HARDWOODS FORM CLASSES

Additional data are now available that will aid foresters and timber cruisers in applying Girard tree form classes to more accurately estimate volume of standing timber in southern Illinois. Up to now the only helps for applying these form classes in southern Illinois were those reported by Schnur and Lane.[1] Their report was based on 1,208 trees measured throughout the State. We now have data on 1,157 additional trees measured in three locations in the southern part of the State (table 1).

Table 1.--Form class by species, diameter class, and location

Species	Total trees	Trees 11-16 inches d.b.h.			Trees 17 inches d.b.h. and larger		
		South-western Illinois	South-central Illinois	South-eastern Illinois	South-western Illinois	South-central Illinois	South-eastern Illinois
	Number						
Hickory	100	78	77	76	-	80*	78*
White oak	415	78	77	75	79	78	76
Black oak	318	76	77	74	78	77	77
Northern red oak	63	80	81	76	87*	84*	81*
Scarlet oak	141	80	82	79	-	79*	81
Southern red oak	20	-	77	-	-	76*	-
Post oak	14	-	76	-	-	-	-
Yellow-poplar	86	82	-	77*	82	-	76*

*Based on only 3 to 7 trees each.

Form class of all species measured consistently decreases from west to east in southern Illinois. The reason for this is not known. Furthermore, the larger trees have a generally higher form class than the smaller trees. This latter trend was previously reported for trees up to 32 inches d.b.h. in Illinois. There was no difference in form class between the best and the poorest sites within any of the three locations.

1/ Schnur, G. Luther and Lane, Richard D. 1950. Aids for computing tree volumes in Illinois. Central States Forest Expt. Sta. Tech. Paper 115, 26 pp.

Form classes were computed as follows:

$$\text{Form Class} = \frac{\text{(diameter inside bark at 17 feet)}}{\text{(diameter outside bark at 4 1/2 feet)}} \times 100$$

All diameters were measured to 1/10-inch with a diameter tape. The double bark thickness at 17 feet was the sum of two measurements taken with a Swedish bark punch. All measurements at 17 feet were taken from a lightweight ladder. Samples were well distributed over the diameter range of 11 through 24 inches d.b.h. and about equally distributed between the three locations.

It is suggested that the form class in table 1 which best fits a local situation be used. However because there are some blanks in this table, average form classes for all locations may be of more practical use (table 2). These are based on the present study but are supplemented, as indicated, by additional data collected previously throughout the State of Illinois.

Table 2.--Suggested average form class by species and tree size

Species	Trees 11-16 inches d.b.h.	Trees 17 inches d.b.h. and larger
Hickory	77	79*
White oak	77	78
Southern red oak	77	78*
Black oak	76	77
Northern red oak	79	80*
Scarlet oak	80	80
Post oak	75*	76*
Yellow-poplar	80	80

*These form classes are weak. They are based on a compromise between data from the present and the earlier studies.

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STATION NOTE

No. 117
June 1958

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

AIRPLANE-SPRAYED HERBICIDES RELEASE SHORTLEAF PINE FROM HARDWOODS

Application of herbicides from an airplane is a satisfactory and relatively cheap method of releasing shortleaf pine from competing low-quality hardwoods. Pine grows among or under hardwoods on several million acres in Missouri. Many sites are better suited for growing pine than hardwoods, but the growth of the existing pine is often retarded by hardwoods. Many of the hardwoods have little or no potential value.

Cutting or girdling the competing hardwood trees is costly and usually provides only temporary release because of profuse sprouting from the stumps. Applying herbicides by hand in frills or on stumps is also expensive but this method results in greatly reduced subsequent sprouting. Preliminary results of two cooperative studies indicate that satisfactory release of shortleaf pine from unwanted hardwoods can be attained at much lower cost when the herbicides are applied from an airplane.[1/]

The studies were made in oak-pine stands where the pine trees ranged from less than 1 to more than 50 feet in height. The much more numerous hardwood trees ranged in size from dense sprout reproduction and saplings to dominating cull sawlog trees.

A 5-gallon solution of 2 pounds of either 2,4,5-T or 2,4,5-TP acid and fuel oil was applied to each acre in June and early July.

The herbicides were equally effective, causing an average of 90 percent defoliation of the hardwood trees during the first growing season. About half these trees died after 2 years. Although many sprouts have developed on the living trees, the trees are low in vigor and many will probably die in the next few years.

No pine trees were killed by the herbicides but some of the needles, as many as 75 percent on some trees, turned reddish-brown and fell off. In every case, however, new needles developed during the same growing season. Although the herbicides caused some damage to growing pine tips, the trees recovered with no apparent adverse effect on form or vigor. On areas released by aerial spray, the pines grew 50 percent more during the second growing season than similar unreleased pines. It is expected that this release will be adequate for continued good growth of the pines.

1/ Weed Control Section, Agricultural Research Service and Missouri National Forests, Forest Service, cooperated in these studies.

Contract costs of aerial spraying vary with the size and location of the operation, the cost of materials, and competition among contractors. In these studies, treatment cost $7.75 per acre on a 40-acre tract and $4.92 per acre on an area of 800 acres. (Because of the difference of quantities purchased, cost of the herbicide and fuel oil per acre averaged $4.25 for the small area and $3.50 for the large area.) Comparable release by hand methods would cost from $12.50 to $25.00 per acre.

These studies have shown that aerial application of herbicides greatly reduces unwanted hardwood competition, and provides adequate release for shortleaf pine at much less cost than comparable hand methods.

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STATION NOTE

No. 116
May 1958

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

Heavy "Thinning" Is Poor Practice In Mature Shortleaf Pine

Hwd Competition

Heavy thinning in an effort to stimulate growth has proved to be a poor prescription for mature, old-field stands of shortleaf pine in Kentucky. In one partially stocked stand on the Cumberland Plateau, cutting nearly 45 percent of the volume resulted in a serious loss of growth for the stand. Moreover, opening up the stand created conditions favorable for the rapid expansion of the hardwood understory. This in turn effectively prevented the development of pine reproduction.

The 3-acre plot is located on a broad ridgetop and is part of an old-field stand of nearly pure 90-year-old shortleaf pine that was grazed and periodically burned prior to the mid-1930's. So far as is known, no cutting had taken place in it prior to 1948. The site index is 72.

Apparently the stand has always been lightly stocked. Before cutting it contained only 84 pines per acre with a basal area of 95 square feet (table 1). A fully stocked stand of the same age and site should contain more than twice as many per acre and nearly twice as much.[1] The stand also contained an understory of hardwood saplings many of which probably developed after grazing and fire were eliminated.

Table 1.--Stand per acre, 1947 and 1956

Stand	No. trees	Basal area	Volume[1]
		Sq. ft.	Bd.-ft.
1947			
Before cutting	84.4	94.7	20,970
Cut	41.6	43.0	9,095
Residual	42.8	51.7	11,875
1956	42.8	60.5	14,930

1/ International 1/4-inch rule. Form class 86.

1/ U. S. Department of Agriculture. Volume, yield, and stand tables for second-growth southern pines. Misc. Pub. 50, 202 pp., 1929.

In February 1948 the stand was cut on an individual tree basis to remove about 40 percent of the volume. Some trees were removed in each diameter class although the cut was slightly heavier in the lower diameters. A light salvage cut the following winter removed 5.6 trees per acre that had been damaged by insects. Growth rates for the residual trees before and after cutting are shown in table 2.

Table 2.--Growth rates for trees in the residual stand 1943-1956

Period	Annual growth per acre: Basal area	Annual growth per acre: Volume
	Sq. ft.	Bd.-ft.
1943-1947 (Before cutting)	0.78	295
1948-1956 (After cutting)	.99	340

The growth of the residual stand increased by about 45 board-feet per acre per year following the cutting. But the trees that had been removed amounted to nearly half the original stand. If they had not been cut their annual growth would have amounted to much more than 45 board-feet per acre, possibly 3 to 4 times as much. Thus 45 board-feet per acre was gained on trees with an average diameter of 15 inches by sacrificing several times that amount on trees averaging nearly 14 inches in diameter.

Equally as serious, the openings that resulted, while too small to be of much benefit to pine seedlings, permitted the hardwood understory to develop profusely. This underbrush, composed largely of dogwood, red maple, sourwood, oaks, and hickory, has prevented the establishment of any pine reproduction. Some pine seedlings got started in seed spots that were raked in the larger openings in 1951 or 1952. But by 1956 the little pines that still survived were completely overtopped by hardwood brush.

In the future, treatment of stands similar to this one should be aimed at maintaining or increasing stocking so as to increase volume and control the underbrush. Periodic light thinnings could probably be used to release selected crop trees and maintain their rate of growth. Unless required for sanitation or salvage, heavy cutting should be avoided until the stand is to be regenerated, and then the cutting should be heavy enough to provide sufficient light and growing space for pine seedlings. Even so ground preparations or the use of herbicides to control the hardwood understory may be necessary.

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STATION NOTE

No. 115
May 1958

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

FROST DAMAGE TO YELLOW-POPLAR VARIES BY SEED SOURCE AND SITE

Frost damage in a 3-year-old yellow-poplar plantation in eastern Muskingum County, Ohio, appears to be associated with seed source and site. The planting consists of two blocks of 490 trees from 7 different seed sources. One block is at the bottom of a northeast-facing slope and the other is on the upper slope above it. Plantation survival has been poor partly because of heavy Herbaceous cover.

Early in May 1957, 80-degree weather stimulated rapid growth of many trees. But on the nights of May 4, 5, and 6 temperature dropped to below freezing -- not an unusual occurrence in this section at this time of year. A month later all trees in both blocks were found to have been frost damaged. Some had died back to the ground. About two-thirds of these were killed outright; the rest sprouted from the root collar. Some of the trees that suffered damage only to the leader developed multiple stems later in the summer.

The extent of dieback was generally related to latitude of the seed source. Trees grown from seed produced at the four locations farthest to the south were much harder hit than those from the three more northern sources (table 1). Forty-seven percent dieback in southern Illinois seems high, but all other plantings from this particular seed source have done very poorly.

The lower slope is apparently in a "frost pocket" because percent of frost damage there was nearly 4 times that in the upper block. Moreover, second-year survival in the lower block was very poor, probably as a result of frost damage in previous years.

Table 1.--Relation of seed source to frost-caused dieback in a 3-year-old yellow-poplar plantation

Seed source	Dieback
	Percent
Dowagiac, Michigan	3.9
Marietta, Ohio	10.6
Orange County, New York	16.4
Perry County, Indiana	30.5
Oxford, Mississippi	30.0
Asheville, North Carolina	31.8
Jonesboro, Illinois	47.0

These results emphasize the desirability of using locally produced seed in forest plantings. Frost resistance is one of the most important reasons for this. Late frost may be responsible for poor survival, slow growth, and production of multiple stems. Of the trees from the three most southerly sources (Illinois, North Carolina, Mississippi) 79 to 94 percent of those originally planted have died from various causes or have been frozen to ground level after only 3 years. However, regardless of seed source, frost damage may be reduced by planting on sites with good air drainage.

David T. Funk, forester
Columbus, Ohio

STATION NOTE

No. 114
April 1958

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

CUMULATIVE-VOLUME TALLY SHEETS FOR POINT SAMPLING

Two very significant improvements in timber cruising techniques, the cumulative tally sheets for 1/5-acre plots developed by Gevorkiantz and the point sampling techniques described by Grosenbaugh and others, were quickly and widely accepted by foresters (4)(3). The advantages of both these improvements can be combined to facilitate cruising and tallying. In addition to a tally of board-foot volume on one side and cord volume on the other, the tally sheet makes possible a record of tree diameter, density or stocking and merchantable lengths encountered.

In point sampling prisms, angle gauges, Spiegel-Relaskops or specially calibrated plot radius tapes, all having a factor of 10, are used. That is, each tree tallied represents 10 square feet of basal area per acre. The attached cumulative-volume tally sheet is designed to facilitate use of any "10-factor" device, but may also be used effectively with other factors.[1]

The composite volume tables prepared by Gevorkiantz and Olsen were used in developing this tally sheet (2). Volumes were multiplied by per acre conversion factors as described by Afanasiev (1). If local conditions require that the composite volume tables be adjusted, the cumulative volumes obtained from these tally sheets may also be adjusted by those factors developed for specific areas.

Ocular estimates of tree diameters are satisfactory because the difference in volume per acre represented by trees within a 4 or 6 inch diameter range is slight. The diameter tally is valuable, however, to indicate the stand structure--that is, the size distribution of the trees. The number of logs or pulp sticks in the trees tallied must be carefully estimated to set an accurate volume estimate.

Species and tree classes may be indicated by varying the symbols used in tallying. Since relatively few trees are tallied per point sample, one tally sheet will serve for many locations. Separate tally sheets may be set up for each forest type, stand-size or other stratification as desired.

1/ If a "5-factor" device is used divide the volumes obtained by 2; if a "20-factor" device is used multiply the volumes obtained by 2, and so on.

When the tally is complete at each location a dot is placed in the cell opposite the number of trees tallied. This provides a measure of stand variability. The sum of these dots also indicates how many point samples have been taken and, therefore, is the divisor to use in calculating volume per acre. This is especially useful if a separate tally sheet is used for each forest type or stand-size class since it provides an indication of stocking characteristics of the stand.

Similar tally sheets may, of course, be readily developed using other volume tables, diameter ranges and basal area factors.

Philip L. Thornton, forester and

O. Keith Hutchison, forest economist

Columbus, Ohio

(1) Afanasiev, Michael
1957. The Bitterlich method of cruising--why does it work? Jour. Forestry 55: 216-217.

(2) Gevorkiantz, S. R. and Olsen, L. P.
1955. Composite volume tables for timber and their application in the Lake States. U. S. Dept. Agr. Tech. Bul. No. 1104, 51 pp., illus.

(3) Grosenbaugh, L. R.
1952. Plotless timber estimates-new, fast, easy. Jour. Forestry 50: 32-37, illus.

(4) Macon, John W. and Gevorkiantz, S. R.
1942. Estimating volume on the spot. Jour. Forestry 40: 652-655, illus.

CUMULATIVE VOLUME TALLY— BOARD-FEET (INT $\frac{1}{4}$)

Based on point-sampling with a critical angle of 104.18 minutes (basal area factor of 10) and composite volume tables developed at the Lake States Forest Experiment Station, 1955. (Table 2, USDA Tech. Bull. No.1104)

PROJECT NAME ______________________ **CRUISER** ______ **DATE** ______

COUNTY ____________________ **STATE** ______ **RGE** ___ **TWP** ___ **SEC** _____

TYPE ____________________ **STAND-SIZE** __________ **CULL** ______

TREE TALLY AT POINT	NUMBER OF POINTS LOCATED (TALLY)
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
TOT	

TO FIND VOLUME

VOLUME IN BOARD FEET PER ACRE (INTERNATIONAL $\frac{1}{4}$-INCH)

Multiply the sum of the last figures used in each block by 10 and then divide the total by the number of point samples tallied.

NO. OF 16' LOGS — VARIABLE TOP TO 8" D. I. B.

DBH	½	1	1	1 ½	1 ½	2	2	2½	2½	3	3½	4	TOTAL BF/ACRE
12	38	73	145	102	204	127	255						
	76	218	290	306	408	382	510						
	115	363	436	510	612	637	764						
	153	508	581	713	815	892	1019						
	191	654	726	917	1019	1147	1274						
	229	799	871	1121	1223	1401	1529						
14	39	74	148	103	206	131	262	153	305	172	182	192	
	79	222	296	309	412	393	524	458	610	344	363	384	
	118	370	444	515	618	655	786	763	915	517	545	576	
	157	518	592	721	824	917	1048	1068	1221	689	726	768	
	197	665	739	927	1030	1179	1310	1373	1526	861	908	959	
	236	813	887	1133	1236	1441	1572	1678	1831	1033	1090	1151	
16	42	75	151	105	211	129	258	153	305	177	196	212	
	85	226	301	316	422	387	516	458	611	354	393	423	
	127	376	452	527	632	645	774	764	916	531	589	635	
	169	527	602	738	843	903	1032	1069	1221	708	786	846	
	212	678	753	949	1054	1162	1291	1374	1527	886	982	1058	
	254	828	903	1159	1265	1420	1549	1680	1833	1063	1179	1269	
18	42	76	153	106	213	133	266	157	315	181	204	226	
	84	229	306	319	426	399	532	472	629	362	408	453	
	126	382	458	532	638	665	798	787	944	543	611	679	
	168	535	611	745	851	931	1064	1101	1259	724	815	906	
	209	688	764	958	1064	1197	1330	1416	1574	906	1019	1132	
20	42	78	156	108	217	135	271	161	321	184	207	230	
	84	234	312	325	433	406	542	482	643	367	413	459	
	127	390	468	542	650	677	812	803	964	551	620	688	
	169	546	624	758	867	948	1083	1125	1285	734	826	918	
22	42	79	158	110	220	137	274	163	326	188	210	231	
	85	238	317	330	440	412	549	489	652	375	421	462	
	127	396	475	550	659	686	823	815	978	563	631	694	
24	42	80	160	110	220	137	273	162	324	189	213	235	
	85	240	321	330	440	410	547	487	649	378	426	471	
	127	401	481	550	660	684	820	811	973	568	639	706	
26	43	81	163	111	222	138	276	164	328	190	214	238	
	86	244	325	333	444	415	553	492	656	379	428	477	
	128	406	488	556	667	691	829	820	984	569	642	715	
28	44	81	163	112	225	139	278	164	328	190	215	239	
	88	244	326	337	449	418	557	491	655	379	431	477	
	131	407	489	562	674	696	835	819	983	569	646	716	
30	45	84	167	112	224	140	279	165	330	190	216	241	
	90	251	335	337	449	419	559	496	661	379	432	481	
32	45	84	168	114	227	141	283	166	333	192	217	242	
34	46	84	169	115	231	143	286	169	337	192	219	243	
36	47	85	170	116	233	143	287	169	338	195	220	245	

TALLY LEGEND

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CUMULATIVE VOLUME TALLY — ROUGH CORDS

Based on point-sampling with a critical angle of 104.18 minutes (basal area factor of 10) and composite volume tables developed at the Lake States Forest Experiment Station, 1955. (Table 6, USDA Tech. Bull. No. 1104)

PROJECT NAME ______________________ CRUISER __________ DATE __________

COUNTY ______________________ STATE ______ RGE ______ TWP ______ SEC ______ FTY ______

TYPE ______________________ STAND-SIZE ______________ CULL ______________

TREE TALLY AT POINT	NUMBER OF POINTS LOCATED (TALLY)
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
TOT.	

TO FIND VOL.

VOLUME IN ROUGH CORDS PER ACRE

Multiply the sum of the last figures used in each block by 0.01 and then divide the total by the number of point samples tallied.

NO. OF 8' BOLTS PER TREE — VARIABLE TOP TO 4" D. I. B.

TALLY LEGEND

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X
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D.B.H.	1	2			3		4		5		6	7
6	87	143	285	428	204	408	240	479				
	173	571	713	856	612	815	719	958				
	260	999	1142	1284	1019	1223	1198	1437				
	347	1427	1570	1712	1427	1631	1677	1916				
	433	1855	1998	2140	1835	2038	2156	2395				
	520	2283	2426	2568	2242	2446	2635	2874				
	606	2711	2854	2996	2650	2854	3114	3353				
8	89	143	287	430	195	390	249	748	304	608	332	
	178	573	716	860	585	780	997	1247	911	1215	665	
	267	1003	1146	1290	974	1169	1496	1745	1519	1823	997	
	355	1433	1576	1720	1364	1559	1995	2244	2127	2430	1330	
	444	1863	2006	2150	1754	1949	2493	2743	2734	3038	1662	
	533	2293	2436	2579	2144	2339	2992	3241	3342	3646	1995	
	622	2723	2866	3009	2534	2728	3491	3740	3949	4253	2327	
	711	3153	3296	3439	2923	3118	3989	4239	4557	4861	2660	
10	90	150	301	451	204	407	244	488	293	587	345	387
	180	602	752	902	611	814	732	976	880	1174	690	774
	270	1053	1203	1354	1018	1221	1220	1464	1467	1761	1034	1161
	359	1504	1654	1805	1425	1629	1707	1951	2054	2348	1379	1548
	449	1955	2105	2256	1832	2036	2195	2439	2641	2934	1724	1935
	539	2406	2557	2707	2239	2443	2683	2927	3228	3521	2069	2322
	629	2857	3008	3158	2646	2850	3171	3415	3815	4108	2414	2709
	719	3309	3459	3609	3054	3257	3659	3903	4402	4695	2758	3096
12	89	154	308	462	210	420	252	504	287	573	331	382
	178	617	771	925	631	841	757	1009	860	1147	662	764
	268	1079	1233	1387	1051	1261	1261	1514	1433	1720	994	1147
	357	1542	1696	1850	1471	1682	1766	2018	2007	2293	1325	1529
	446	2004	2158	2312	1892	2102	2270	2522	2580	2866	1656	1911
	535	2466	2621	2775	2312	2523	2775	3027	3153	3440	1987	2293
	624	2929	3083	3237	2733	2943	3279	3532	3726	4013	2319	2675
14	89	156	313	469	213	427	256	511	291	582	330	374
	178	625	782	938	640	854	767	1022	873	1164	661	749
	267	1094	1250	1407	1067	1280	1278	1533	1456	1747	991	1123
	356	1563	1719	1876	1494	1707	1789	2044	2038	2329	1322	1498
16	87	158	315	473	215	430	263	526	30	60	34	38
	175	631	789	946	645	860	789	1053	90	120	67	76
	262	1104	1262	1420	1076	1291	1316	1579	151	181	101	114
18	88	160	319	479	216	432	266	532	211	423	340	368
	175	638	798	958	649	865	798	1064	634	845	679	736
20	89	162	324	486	220	441	271	542	312	624	349	372
	178	648	810	972	661	881	812	1083	936	1248	698	744
22	91	167	334	500	227	455	277	553	318	637	352	379
	182	667	834	1001	682	910	830	1107	955	1273	705	758

TOTAL

CORDS/ACRE

NOTES ____

STATION NOTE

No. 113
March 1958

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio
W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

BUNDLING HARDWOOD SLABS FOR BETTER MARKETING

Hardwood slabs and edgings are becoming an important by-product of sawmills in some areas of the Central States. These residues are used to manufacture charcoal, wood pulp, and chips for metalurgical industries.

Bundling the slabs aids in loading and unloading. It eliminates much of the hand labor. For example, it took about 8 man-hours to load 6 cords of slabs on the truck in figure 1 when the slabs were hand-loaded piece by piece. In contrast, only about 2 man-hours were required to strap the bundles and load them on the truck with a truck-mounted A-frame. The equipment necessary to bundle slabs consists only of a simple cradle and strapping machine (fig. 2).

Slabs are usually bought either by weight or by volume but the relationship between these two units is highly variable because of moisture content, care in stacking or bundling slabs, etc. One source of variation in the weight of a cord of bundled hardwood slabs is length of the bundle. Short bundles tend to have fewer pieces shorter than the length of the bundle and therefore are more uniform in weight. This was demonstrated recently by a study conducted at a sawmill in eastern Ohio.

Figure 1.--Bundled slabs loaded on a flatbed semi-trailer.

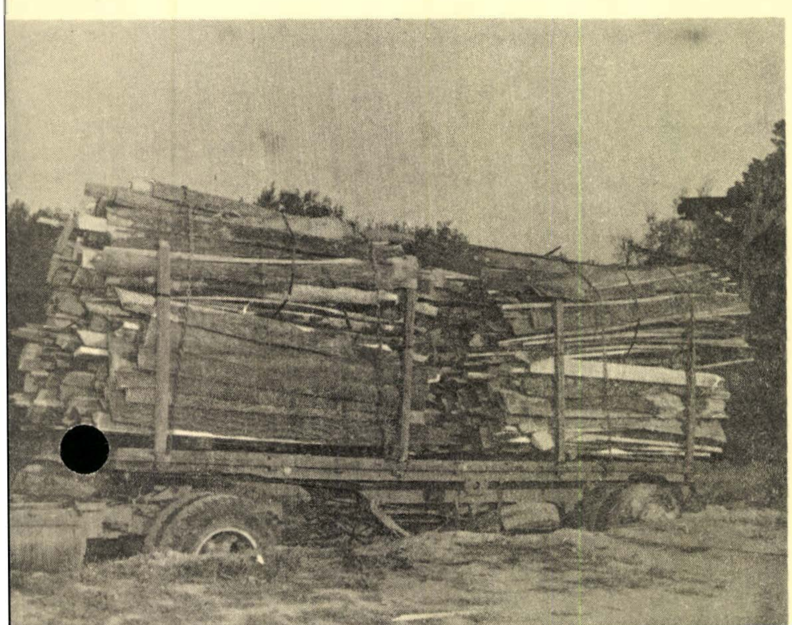
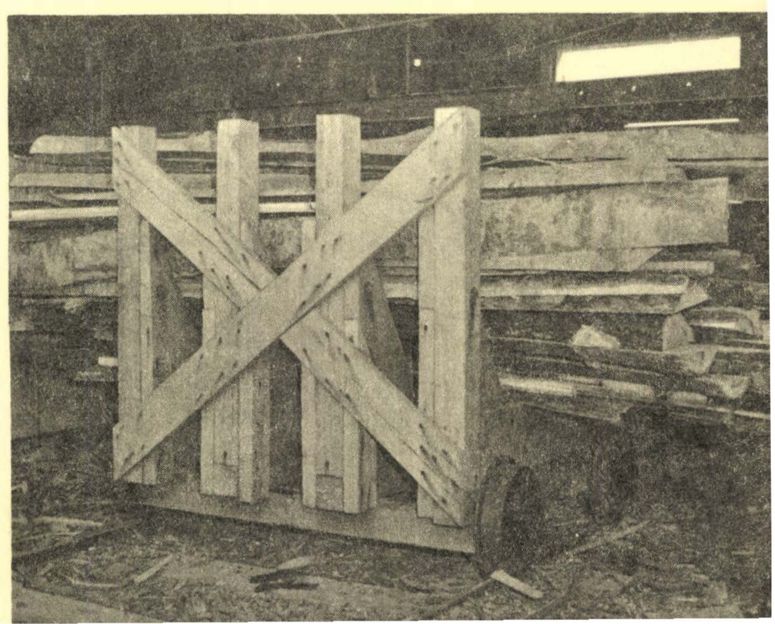


Figure 2.--Cradle at end of mill for bundling slabs.



Volume and weight measurements were made on 80 bundles 10 feet long and on 55 bundles 8 feet long. All of the slabs were green when measured and weights were taken within 7 days after sawing. A lumber tally of the logs from which these slabs were cut showed the following species composition (oak 50 percent; beech, elm 25 percent; hard maple, hickory, black gum, yellow-poplar 25 percent).

Two measurements were taken at each end of the bundles to obtain a mean bundle diameter. Cross-sectional area was multiplied by length to obtain cubic volume which in turn was divided by 128 to convert to standard cords.

The bundled slabs usually weighed between 2,900 and 3,200 pounds per cord. The 8-foot bundles averaged heavier per cord with less variation than did the 10-foot bundles.

	Cords per ton	Pounds per cord	
	Average	Average	Variability 1/ (percent)
8-foot bundles	0.635	3,150	1.2
10-foot bundles	.676	2,966	5.9

The study indicates that short bundles tend to have a more uniform weight-volume relationship, thus simplifying marketing slabs by weight. However, other considerations such as the average length of logs being sawed, transportation and loading equipment available, and preference of the purchaser may make longer bundles more desirable.

Roy A. Whitmore, forest economist
New Philadelphia, Ohio

1/ Coefficient of variation.

No. 112
December, 1957

STATION NOTE

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

Veneer-Log Production and Consumption in the Central States - 1956

About 55 million board-feet of veneer logs were harvested from Central States forests in 1956. This figure was obtained by a recent canvass of plants drawing veneer logs from this area;1/ it includes logs used for container veneer as well as those used for face or commercial veneer.

About half the veneer mills in the Central States manufacture face or commercial veneer. However, these mills received 61 percent of the veneer logs harvested in the region. Ohio, Illinois, and Missouri mills used only 10 percent of their logs for face or commercial veneer. On the other hand, Indiana, Kentucky, and Iowa mills used almost 90 percent of their veneer logs for this purpose.

Ten percent of the veneer-log volume harvested in the Central States in 1956 was exported to the Lake States, West Virginia, and Tennessee. However, about 16 percent of the volume of veneer-log material received at mills in the Central States was imported from the Lake States, West Virginia, Tennessee, Pennsylvania, Virginia, and elsewhere. Red oak, cottonwood, and soft maple made up two-thirds of veneer-log volume shipped out of the Central States. Eighty percent of the veneer-log volume imported to the Central States was oak, walnut, cherry, and cottonwood. Further evidence that interstate shipping of veneer logs is common is the fact that only about half the veneer logs received at Central States mills were harvested in the State where they were used (table 1).

Table 1.--Veneer logs consumed at central states mills in 1956
(1,000 Board-feet International 1/4-inch rule)

	Mill location					
	Ohio	Ind.	Ill.	Ky.	Mo.& Ia. 2/	Total
A. Source of logs						
Ohio	4,667	2,676	--	109	--	7,452
Indiana	249	9,049	--	98	--	9,396
Illinois	104	2,461	4,798	257	55	7,675
Kentucky	43	6,136	245	3,932	1,100	11,456
Missouri	160	1,044	899	--	4,346	6,449
Iowa	121	3,453	762	385	1,517	6,238
Imported 1/	314	3,960	187	3,316	1,668	9,445
Total	5,658	28,779	6,891	8,097	8,686	58,111
B. Species						
Red oak	6	1,044	138	1,232	82	2,502
White oak	29	6,259	23	1,486	454	8,251
Hickory	107	605	--	--	--	712
Sycamore	142	864	323	320	82	1,731
Elm	1,078	425	293	--	55	1,851
Gum	81	1,651	86	434	--	2,252
Yellow-poplar	282	2,824	--	2,345	--	5,451
Hard maple	1,257	891	13	--	273	2,434
Soft maple	352	311	69	10	401	1,143
Cherry	--	1,426	4	445	--	1,875
Walnut	837	10,316	1,055	1,705	--	13,913
Beech	1,020	11	--	--	--	1,031
Cottonwood	260	1,006	4,580	--	5,382	11,228
Other	207	1,146	307	120	1,957	3,737
Total	5,658	28,779	6,891	8,097	8,686	58,111

1/ Logs harvested outside the Central States.
2/ Combined to avoid possible disclosure of individual mill receipts.

1/ One large mill did not report and is excluded from this estimate.

Logs of many species are used to produce veneer at mills in the Central States. However, about three-fourths of the receipts at mills making face veneer were walnut, oak, and cherry. At container veneer plants, cottonwood, elm, sycamore, and yellow-poplar logs made up about three-fourths of the volume. Sixty-two percent of all veneer-log volume received at mills in the Central States in 1956 was walnut, oak, and cottonwood (table 2).

Table 2.--Source and destination of veneer logs harvested in the central states-1956

(1,000 Board-feet International 1/4-inch rule)

Source	Destination	Red oak	White oak	Hickory	Sycamore	Elm	Gum	Yellow-poplar	Hard maple	Soft maple	Cherry	Walnut	Beech	Cotton-wood	Other	All species
	Ohio	6	29	107	126	1,020	82	266	1,101	329	--	204	981	260	156	4,667
	Other Cent. States	140	1,740	--	--	1	--	29	9	--	2	837	--	--	27	2,785
Ohio	Mills Outside C.S.	788	110	--	--	--	--	284	--	--	11	44	--	--	42	1,279
	Total	934	1,879	107	126	1,021	82	579	1,110	329	13	1,085	981	260	225	8,731
	Indiana	327	2,330	110	148	104	517	1,018	192	305	26	3,336	11	182	443	9,049
	Other Cent. States	2	7	--	--	--	--	33	94	--	--	196	--	--	15	347
Indiana	Mills Outside C.S.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0
	Total	329	2,337	110	148	104	517	1,051	286	305	26	3,532	11	182	458	9,396
	Illinois	31	11	--	319	257	81	--	8	65	--	167	--	3,615	243	4,797
	Other Cent. States	189	213	--	30	28	376	510	10	19	--	1,338	--	--	165	2,878
Illinois	Mills Outside C.S.	86	--	--	--	146	--	--	6	153	--	--	--	302	5	698
	Total	306	224	--	349	431	457	510	24	237	--	1,505	--	3,917	413	8,373
	Kentucky	696	389	--	283	--	372	1,714	--	10	94	295	--	--	79	3,932
	Other Cent. States	212	1,100	495	717	319	789	1,334	28	30	23	256	--	2,164	57	7,524
Kentucky	Mills Outside C.S.	392	--	--	44	18	88	174	--	31	--	--	--	220	82	1,049
	Total	1,300	1,489	495	1,044	337	1,249	3,222	28	71	117	551	--	2,384	218	12,505
Missouri and Iowa	Missouri & Iowa[1]	82	454	--	82	28	--	--	277	382	--	--	--	[3] 2,[illegible]	1,945	5,864
	Other Cent. States	6	406	--	2	23	--	66	--	2	4	[2] 5,565	--	[3] 727	22	6,823
	Mills Outside C.S.	388	--	--	--	358	--	--	213	848	--	--	--	595	296	[4] 2,698
	Total	476	860	--	84	409	--	66	490	1,232	4	5,565	--	3,936	2,263	15,385
All Central States	Central States	1,691	6,679	712	1,707	1,780	2,217	4,970	1,719	1,142	149	12,194	992	9,562	3,152	48,666
	Mills Outside C.S.	1,654	110	--	44	522	88	458	219	1,032	11	44	--	1,117	425	5,724
	Total	3,345	6,789	712	1,751	2,302	2,305	5,428	1,938	2,174	160	12,238	992	10,679	3,577	54,390

1/ Combined to avoid possible disclosure of individual mill receipts.
2/ 75 percent harvested in Iowa.
3/ 100 percent harvested in Missouri.
4/ 100 percent harvested in Iowa.

Similar canvasses of the veneer industry are scheduled for alternate years to provide reliable statistics. These will be used to estimate timber cut and to calculate and project trends in veneer-log production and consumption in the Central States.

Philip L. Thornton, forester
Columbus, Ohio

STATION NOTE

No. 111
December 1957

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

DISKING INCREASES SHORTLEAF PINE REPRODUCTION, BUT...

Ridgetops and upper slopes of the Cumberland Plateau section of eastern Kentucky are usually stocked with hardwoods or a mixture of shortleaf pine and hardwoods. Natural succession, aided by past cutting practices, has tended to increase the hardwoods at the expense of the pine. Most of the hardwoods on these sites are of low quality and often of undesirable species. In order to increase the amount of pine on these sites, some method of stimulating natural regeneration of pine and destroying the existing hardwood understory is necessary.

One known method of stimulating pine regeneration is to expose the mineral soil by disking. In order to test the effectiveness of this method, an exploratory study was established in a shortleaf pine-hardwood stand on the Cumberland National Forest in late 1952. Much hardwood reproduction was already present in the understory. A harvest cut was made in this stand that left a varying number of shortleaf pine seed trees per acre. The treated plots were disked with the Athens Fire Lane Harrow which exposed mineral soil and cut up many of the small hardwood stems (fig. 1). Disking was done at the time of and following logging.

Where there was an adequate number of shortleaf pine seed trees disking helped in getting pine reproduction established (table 1). Four years after treatment there was an average increase of 815 pine seedlings per acre on the disked plots. On the plots that were not disked this increase was 210 pine seedlings per acre.

Figure 1.--The Athens four-disk Fire Lane Harrow used in disking operation.

Table 1.--Character and extent of reproduction in 4 pine-hardwood stands as affected by disking and number of seed trees
(Number per acre)

PINE REPRODUCTION

Pine seed trees per acre (number)	Disked			Not Disked		
	1952[1]	1957	Increase	1952[1]	1957	Increase
1	50	50	0	100	100	0
3	0	150	150	50	50	0
10	200	1,150	950	550	1,400	850
20	0	2,150	2,150	100	100	0

HARDWOOD REPRODUCTION

Pine seed trees per acre (number)	Disked			Not Disked		
	1952[1]	1957	Increase	1952[1]	1957	Increase
1	850	20,850	20,000	10,800	18,150	7,350
3	2,350	23,350	21,000	7,550	11,650	4,100
10	1,700	7,550	5,850	5,200	13,450	8,250
20	0	15,200	15,200	1,800	12,950	11,150

1/ A tally of reproduction under 1 inch d.b.h. was made on all plots when disking was completed and before the first growing season after disking.

This study shows that although disking will provide seedbed conditions necessary for the establishment of pine seedlings it does not eliminate the hardwoods. In fact, this treatment will increase the number of hardwood stems. On the plots that were disked the number of hardwood sprouts increased an average of 15,500 per acre. The increase on the undisked plots was 7,700 per acre. Unfortunately, these sprouts grow much faster than the pine seedlings. After 4 or 5 years it is likely that the hardwoods will have developed to the point where they overtop the pine.

Current studies testing various methods of site preparation will provide information on the effect these hardwood sprouts will have on the eventual stocking of pine. However, it now appears that, in order to be successful, disking will have to be supplemented by a more effective means of controlling the hardwoods.

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No. 110
November 1957

STATION NOTE

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

Scarifying Seedbed Boosts Yellow-poplar Germination

A recent study in southern Indiana showed that yellow-poplar germination was 10 times greater on a scarified seedbed than on undisturbed forest floor. It is well known that scarification improves germination but quantitative results have been lacking. Here is a case record that provides more information on yellow-poplar regeneration.

During the fall of 1956 a defective oak-hickory stand on the Wayne-Hoosier National Forest in Indiana was given a heavy improvement cut. The logged area was adjacent to a stand containing yellow-poplar trees which provided a good source of seed.

In July 1957 each of 72 randomly located milacre quadrats in the logged stand was mapped into three condition classes: (1) Undisturbed forest floor, (2) mineral soil (usually in skid trails and loading areas), and (3) scarified forest floor (generally, strips alongside skid trails and around stumps).

These plots contained 741 yellow-poplar seedlings, a stocking of more than 10,000 seedlings per acre. Distribution was extremely variable, ranging from 0 to 61 per quadrat. Three-quarters of the seedlings were on the disturbed forest floor (scarified and mineral soil) which occupied only a little more than one-quarter of the area (table 1). Nevertheless, 82 percent of all the quadrats were stocked with one or more seedlings and 72 percent were stocked with 2 or more seedlings.

Table 1.--Surface condition classes and distribution of seedlings

Seedbed	Area	Number of seedlings	Seedlings per milacre
	Percent	Percent	Number
Undisturbed	73	23	3.2
Scarified	17	50	30.9
Mineral	10	27	27.2
Total	100	100	

At present, the stocking on even the undisturbed litter appears adequate. However, rainfall was much greater than normal and was well distributed through the 1957 growing season. In a drier year germination in litter would probably be reduced more than germination on disturbed forest floor.

The study shows clearly that scarification is an aid to good yellow-poplar seedling establishment. Skidding should be directed through openings and sparsely stocked portions of the stand near seed trees. Scarification as a cultural measure may be worthwhile if logging does not provide a suitable seedbed. Because yellow-poplar seedlings are intolerant, cultural work should be confined to openings for maximum regeneration and best growth.

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STATION NOTE

No. 109
September 1957

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio
W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

1956 CHARCOAL PRODUCTION in the Central States

Thirty-thousand tons of bulk charcoal were produced in Illinois, Kentucky, Missouri, and Ohio in 1956 according to a recent complete canvass of the industry. To obtain this production, 41 producing plants--with a total of 282 kilns--used 50 thousand cords of roundwood and 19 thousand cords of mill residues.

Production in 1956 was estimated to be 40 percent higher than in 1955--an indication of the rapidly rising interest in charcoal production in recent years. Less than 20 percent of the plants producing today were in operation before 1946. This expansion coincided with the increased use of charcoal for outdoor cooking in the past 10 years.

Charcoal plants in Missouri accounted for more than 70 percent of the total production in the Central States (table 1). Ohio, Illinois, and Kentucky were next in importance--no charcoal was produced commercially in Indiana or Iowa. Production in the Central States amounted to 11 percent of all charcoal produced in the United States in 1956.

Table 1.--Charcoal plants and production, 1956

State	Plant	Production		
		Lumps	Fines	Total
	Number	Tons	Tons	Tons
Missouri	31	17,000	3,900	20,900
Ohio	4	4,500	1,000	5,500
Illinois and Kentucky 1/	6	2,300	500	2,800
Total	41	23,800	5,400	29,200

1/ Combined to avoid possible disclosure of individual production.

Almost all of the 30,000 tons of charcoal produced was marketed in 1956, although apparently there are some areas where overproduction and marketing problems exist. Briquetting plants--fairly new in the Central States--purchased about 41 percent of the bulk charcoal produced. Industrial users and wholesale charcoal dealers provided markets for almost all of the remainder.

The price obtained for charcoal at the kiln varied among states and according to how it was sold. For example, lump charcoal brought about 20 percent more per pound in bags in Ohio than in Missouri. Regionwide, charcoal sold in bulk brought 33 percent less per pound than did bagged charcoal. The average price received for bulk charcoal was $40.64 per ton delivered. Lump charcoal in paper bags ready for retail brought slightly more than 3 cents per pound at the kiln. Retail prices in large cities averaged about 10 cents per pound in 10-pound bags.

Charcoal kilns in the Central States range in capacity from 2 to 70 cords and require from 7 to 34 days for a complete cycle, depending upon the type of structure. Three main types of construction are used--the circular brick beehive, rectangular cinder block, and the arched-roof reinforced concrete.

Virtually all of the wood used to produce charcoal in this region is from hardwood species--more than 90 percent oak and hickory. Most of the wood comes from small trees and tops and limbs of larger trees cut for sawlogs. In some areas, notably Ohio, slabs, edgings, and other coarse residues from sawmills are the chief sources of wood. Most operators report that it takes slightly less than 2 1/2 cords of wood to yield 1 ton of charcoal. Kiln operators paid about $7.00 per cord for roundwood and $6.00 per cord for plant residues delivered at the kiln (table 2).

Table 2.--Volume and average cost per cord of wood delivered at kilns, 1956

State	Roundwood		Residues	
	Volume	Cost	Volume	Cost
	Cords	Dollars	Cords	Dollars
Missouri	44,700	6.89	3,500	5.53
Ohio	200	7.00	13,200	6.00
Illinois and Kentucky	5,200	6.98	2,100	5.92
Total	50,700	6.90	18,800	5.90

The charcoal industry appears to be well established in the Central States. A continuing demand for charcoal that is supplied by converting low-grade, cull, and "waste" material can make this industry an important part of the timber management program in the Central States.

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No. 108
September 1957

STATION NOTE

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

Crown Development: An Index of Stand Density

A study of crown characteristics of several hundred open-grown oak, hickory, and Norway spruce trees in Iowa revealed a high correlation between stem diameter and crown area. Consideration of this relationship led to the idea that perhaps here was a realistic way to measure and evaluate stand density or stocking. If, given unlimited growing space, trees of a certain species and diameter developed crowns of almost identical size, why couldn't the extent to which this development is limited in a forest stand be used as an index of stand density? Such an index would also express numerically the amount of competition existing in a stand.

The idea was developed further along these lines: If enough open-grown trees were distributed over an acre of land so that the crowns met but did not overlap, there would be no competition yet no wasted space. Then the percentage of an acre that the crown of each tree occupied would be a significant figure. The sum of these percentages for all the trees on the acre would be 100. This figure was called the "Crown Competition Factor" or CCF. A similar stand containing twice as many trees of the same species and d.b.h. would have a CCF of 200. Because stands having a CCF of 100 would be made up of trees with open-grown form, an optimum CCF for all species would of course be somewhat greater than this.

Encouraging results have been obtained in a limited application of this method. In heavily stocked, even-aged oak stands in Iowa a very consistent CCF value was obtained regardless of site or age of the stands. When the CCF method was applied to yield tables for even-aged upland oak a nearly constant value was also obtained independent of site index and age. The independence of the CCF on site, age, and diameter distribution is a highly desirable feature that is not present in most density control methods. In theory the CCF should apply equally as well to uneven-aged stands, although it has not yet been applied to such stands.

Relatively few measurements of open-grown trees are required, but the sample trees selected should be truly open grown without evidence of past competition. When the relationship between crown diameter and d.b.h. is known, computing the CCF is a simple matter (table 1).

Table 1.--Determination of the Crown Competition Factor (CCF) for an Even-Aged Upland Oak Stand, Age 50, Site Index 50.

D.b.h. (inches)	Trees[1]	Open-grown crown acreage per tree	Total crown acreage
	Number	Percent	Percent
0.25	2	.023	.05
1	25	.044	1.10
2	62	.082	5.08
3	94	.133	12.50
4	115	.196	22.54
5	114	.270	30.78
6	93	.356	33.11
7	61	.455	27.76
8	32	.566	18.11
9	17	.688	11.70
10	7	.822	5.75
11	1	.969	.97
	623		

Crown Competition Factor = 169.45

1/ From: Schnur, G. Luther. Yield, stand and volume tables for even-aged upland oak forests. U. S. Dept. Agr. Tech. Bul. No. 560, table 37, 1937.

A more detailed account of this study will be published soon. The publication will describe the methods used in collecting the field data, the development of the crown competition concept, and the derivation of formulae.

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STATION NOTE

No. 107
September 1957

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio
W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

Ax Girdling Kills Large Cull Hardwoods

Recent tests at the Kaskaskia Experimental Forest in southern Illinois show that notch girdling with an ax kills most large hardwood cull trees but only about half of the small, pole-sized trees. Nearly two-thirds of more than 2,600 girdled cull trees of all sizes were dead 3 years later. About one-third of the trees had dead crowns but were sprouting below the girdles; only 3 percent still had live crowns. Mortality figures for an additional 1,200 trees girdled only 1 year before examination were generally lower, showing that it takes 2 or more years for some of the trees to die (table 1).

Table 1.--Tree condition by season of girdling after 1 and 3 years
(In percent of trees)

Tree condition	Girdled 1 year		Girdled 3 years	
	Growing season	Dormant season	Growing season	Dormant season
Dead crown--no sprouts	64	42	69	62
Dead crown--sprouts	20	32	28	35
Live crown--no sprouts	7	13	1	1
Live crown--sprouts	9	13	2	2

The girdled trees were in mixed hardwood stands in coves and on northerly slopes and in oak-hickory stands on south slopes and ridgetops. Hickory, white oak, black oak, red oak, scarlet oak, blackjack oak, blackgum, and post oak made up 92 percent of the trees girdled.

Season of treatment did not greatly influence effectiveness of girdling oaks, although trees were killed more rapidly when girdled during the growing season. However, girdling of hickory and blackgum was more effective when done during the growing season (table 2). White oak was the easiest to kill and blackgum was the hardest.

The largest trees were most easily killed by notch girdling (fig. 1). Mortality ranged from 51 percent for 5-to-7-inch trees to 87 percent for trees 18 inches and larger.

Table 2.--Mortality[1] by species, season of girdling, and time since girdling

Species	Trees girdled	Girdled 1 year		Girdled 3 years	
		Growing season	Dormant season	Growing season	Dormant season
	number	percent	percent	percent	percent
Hickory	1,218	69	30	76	56
White oak	964	80	63	85	78
Red, black, and scarlet oak	719	83	55	63	60
Blackgum	289	5	2	51	33
All other species	709	45	26	63	60

1/ Trees with dead crowns and no live sprouts.

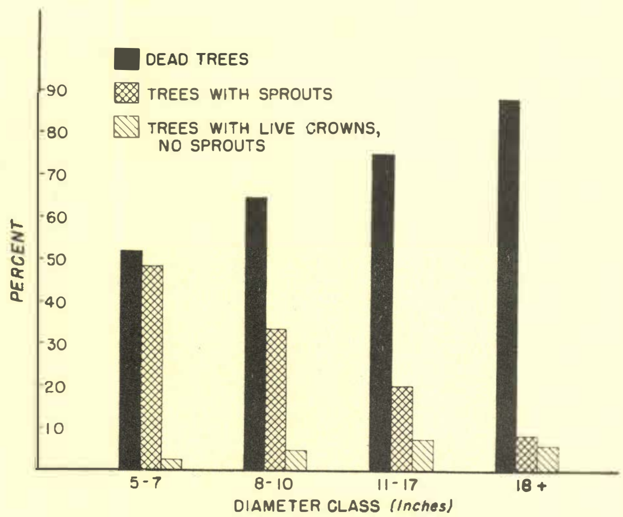

Figure 1.--Condition of girdled trees by diameter classes for all trees examined.

Nearly 60 percent of the sprouting trees produced only sprouts originating below the root collar; about 30 percent produced sprouts only above the root collar; and the others had sprouts in both places. After 3 years many of those produced above the root collar were dead whereas those below tended to persist.

Season of girdling affected length of sprouts but not average number of sprouts produced by girdled trees. All sprouting trees averaged four sprouts each regardless of time of girdling. Sprouts from trees girdled during the dormant season averaged 1 foot longer.

From these results it appears that most large trees can be killed by notch girdling, especially if girdled during the growing season. Killing small trees and hard-to-kill species should be more effective with the proper use of a herbicide in an ax frill.[1]

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1/ University of Missouri, College of Agriculture. How to kill woody plants. Folder No. 26, illus. 1954.

STATION NOTE
No. 106
August 1957

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

Early Development of Yellow-Poplar on Two Planting Sites

Yellow-poplar (Liriodendron tulipifera L.) seedlings planted on a recently cleared forest area in southern Illinois grew better than similar seedlings planted at the same time on an old field (fig. 1). This occurred in spite of the fact that they were competing with, but not overtopped by, a dense cover of hardwood sprouts and seedlings.

A mixed hardwood stand on a lower northwest slope was treated in February 1954 to remove the tree cover. All pole and sawtimber-size trees were frill-girdled and poisoned, and the saplings and smaller woody vegetation were cut and their stumps poisoned. Heavy sprouting followed this treatment creating an extremely dense cover.

The old field had not been farmed for 15 years or more. Vegetation consisted chiefly of herbaceous plants, sumac, and some briars. However, the vegetation was so sparse that no preplanting release was considered necessary.

Figure 1.--Yellow-poplar after 2 1/2 growing seasons. Left - on a forest soil site. Right - on an old-field site.

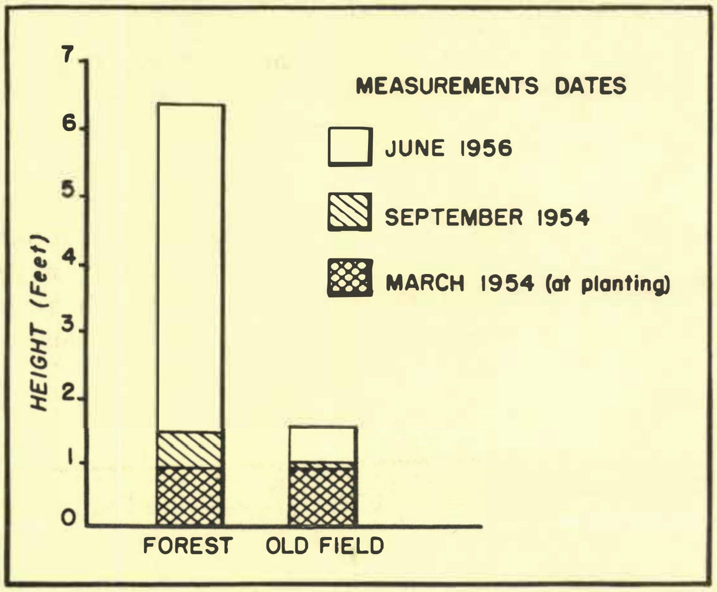

Figure 2.--Heights of yellow-poplar on a previously forested area and an old field.

During March 1954, 14 rectangular 1/10-acre plots were established and planted on the treated area and 10 on the old field. Each plot contained 70 trees spaced 7 x 7 feet. These plantings are part of a larger study underway in Illinois, Indiana, and Ohio to test geographic seed sources and seed-tree characteristics of yellow-poplar.

At the time of planting the average height of the seedlings was about 0.8 feet for both planting sites. At the end of the first growing season the average total height was 1.3 and 0.9 feet respectively for the treated site and the old field (fig. 2). During the third growing season the average total height for trees planted on the forest site was 6.3 feet but only 1.5 feet on the old field. The survival was 83 and 80 percent for the forest site and the old field respectively.

The differences in environmental conditions between these two areas have not been studied. However, the data show that yellow-poplar planted on the recently cleared northwest forest slope have successfully survived and developed during early stages of growth in competition with a dense cover of sprouts and seedlings. These trees had much greater growth and slightly higher survival than those on the old field. Future examinations of these plots will determine whether or not these differences persist.

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STATION NOTE

No. 105
July 1957

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

You Can Kill Post Oak Saplings in Missouri with Ammate and an Ax

Small post oak trees in Missouri are hard to kill by cutting or girdling because of their ability to sprout. Recent tests conducted by the Columbia Forest Research Center in Missouri show that Ammate will greatly reduce sprouting of small post oak stumps. Ammate was applied to freshly cut stumps of 1-, 2-, and 3-inch post oak saplings. Trees were cut with an ax to leave "V" shaped stumps the heights of which did not exceed their diameters.

Immediately after cutting, Ammate was applied to the stump surfaces (a) in the form of crystals, (b) as a solution made up by adding 4 pounds of the crystals to 1 gallon of water (fig. 1), and (c) as a 4-pounds-per-gallon solution thickened with flour to about the consistency of thin pancake batter. Both plain and thickened solutions of Ammate were applied liberally (2 coats) to stumps with a paint brush. Each treatment was applied to 40 trees in September and December of 1950 and June of 1951. To serve as a check, at each date one set of 40 trees was cut but not treated with Ammate.

Figure 1.--
A good kill of post oak saplings can be obtained by applying Ammate solution--4 pounds per gallon--liberally to the cut surfaces immediately after cutting.

The kill of post oak saplings was increased 4 to 7 times by applying Ammate to cut stumps (table 1). Ammate crystals gave good kills at all treatment dates, but the solutions were somewhat less effective in June than in September or December.

Table 1.--Percent of post oak saplings that died by August 1953

Treatment	Date treated		
	September 1950	December 1950	June 1951
Ammate crystals	98	95	90
Ammate solution	82	90	77
Thickened Ammate solution	85	98	70
Check (no Ammate)	20	20	13

But what about dosages and costs? The record of material used shows that the Ammate crystal treatment used 2 pounds of Ammate for 40 stumps (1 teaspoonful per inch of stump diameter). The plain and thickened Ammate solutions, however, used only 1/2 pound and 1 pound, respectively. With the cost of Ammate at 20 cents per pound, the cost of crystals would be 1 cent per tree and for the plain and thickened solutions it would be 1/4 cent and 1/2 cent, respectively. Inasmuch as the December treatments with plain Ammate solution were nearly as effective as the Ammate crystals and cost only one-fourth as much, dormant season treatment with Ammate solution is recommended.

The following procedure is, therefore, suggested for killing sapling-size post oaks with Ammate.

1. Make up solution by adding 4 pounds (about 2 quarts) of crystals to 1 gallon of water.

2. Cut stumps low. The stump should be no higher than it is wide.

3. Apply solution immediately after tree is cut.

4. Apply solution liberally to all cut surfaces with a paint brush. Use a full brush and go over cut surfaces twice.

5. Make treatments during the dormant season.

If for some reason it is necessary to treat stumps during the summer months, or if a particularly high kill is important, use Ammate crystals at rate of 1 teaspoonful per inch of stump diameter.

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STATION NOTE

No. 104
July 1957

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

Pulpwood Production Continues to Increase in the Central States

A recent 100-percent canvass of pulp and fiber mills drawing pulpwood from the Central States revealed that pulpwood production reached 272 thousand standard cords in 1956--31 percent higher than in 1955.[1/] This increase was shared by all of the Central States except Indiana. The following table shows pulpwood production by species groups and compares total production for the 2 years by states:

State	1956 Pulpwood production (Standard cords, unpeeled)				Increase Over 1955
	Pine	Hard hardwoods	Soft hardwoods	All species	
					(Percent)
Ohio	1,100	74,100	20,100	95,300	17
Illinois	100	10,800	69,200	80,100	26
Kentucky	25,000	12,100	16,200	53,300	63
Indiana	0	2,300	19,700	22,000	- 1
Iowa	0	4,000	15,000	19,000	265
Missouri	1,000	200	1,200	2,400	100
All states	27,200	103,500	141,400	272,100	31

In all, 19 mills were found to be using pulpwood produced in the Central States in 1956. Of the pulpwood produced, 26.1 thousand cords (about 10 percent) were consumed at 5 mills located in Tennessee, Virginia, Pennsylvania, and Maryland. About 5 1/2 thousand cords of pulpwood produced in Wisconsin were shipped into mills in the Central States.

Soft hardwoods, including cottonwood, soft maple, yellow-poplar, willow, sycamore, and basswood, made up 52 percent of the total pulpwood production. Hard hardwoods, such as oak, ash, hard

1/ Thornton, Philip L. 1955 Pulpwood Production in the Central States. Cent. States Forest Expt. Sta. Note 100, 2 pp., illus. 1957.

maple, elm, birch, and cherry, accounted for 38 percent. Pine pulpwood made up the remaining 10 percent.

Although a few new plants started operating in 1956, most of the increase in pulpwood production appears to be due to additional consumption by existing plants. The upward trend of pulpwood production seems to be well established.

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11.2.1

STATION NOTE

No. 103
July 1957

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

How to Minimize the Effects of Tension Wood in Cottonwood

Cottonwood (Populus deltoides Bartr.), one of the fastest growing trees in North America, is an excellent raw material for a wide variety of products and uses. Unfortunately, however, the wood from some trees is difficult to season and finish because portions of it tend to warp or buckle excessively while drying and to develop fuzzy or rough surfaces when machined (1, 2, 4). Depending upon the type of product being manufactured, either condition often results in the costly rejection of parts or entire assemblies. This discourages the use of this species for some products and tends to depress the price of cottonwood stumpage and logs.

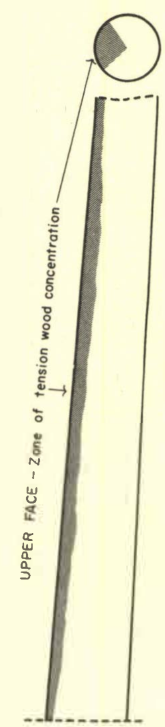

Figure 1.--Tension wood is concentrated in the quarter of the bole that is on the "upper" side of a leaning tree.

The warping and fuzziness of some cottonwood lumber and veneer are caused by the presence of a peculiar type of fiber structure. Because these fibers are usually most abundant on the upper side of leaning stems--that portion of the stem under tension--they are commonly referred to as "tension wood" (fig. 1). However, large amounts have also been found in the concave side of tree boles having pronounced sweep. Lumber or veneer from logs or bolts containing concentrations of tension wood becomes "fuzzy" because these abnormal fibers are torn rather than cut during sawing, planing, shaping, or veneering operations. The wood warps because tension wood shrinks more longitudinally than adjacent wood, thus causing unequal stresses in lumber and veneer.

The more a tree leans, the more tension wood it is likely to contain (3). A tree leaning 4 degrees or more from the perpendicular usually contains objectionable quantities of tension wood and should receive special consideration by the timber manager and logger.

Observations in crowded cottonwood stands indicate that the tendency of this "light-loving" tree to grow toward openings between the tops of neighboring trees is a cause of lean. To minimize tension wood problems in future harvests, the forest manager, when making thinnings and

improvement cuts, should (1) remove all trees leaning more than 4 degrees[1], and (2) provide ample growing space for prospective "crop" trees.

When cottonwood is being harvested and processed, the following precautions should be taken to avoid costly losses resulting from the occurrence of tension wood.

A. Loggers should:
   1. Identify and mark the "upper" face of all logs cut from trees that lean more than 4 degrees.
   2. Leave small logs from the leaning parts of trees in the woods, or identify them for use as raw material for wood chips, pulpwood, car blocking, or other products that do not require dimensional stability or finishing.

B. Sawmill operators should:
   1. When sawing a log identified as coming from a leaning tree, discard the quarter under the "upper" face, or cut that portion into blocking, skids, rough-construction lumber, or similar products.
   2. Treat the concave face of all logs having pronounced sweep as though it were an "upper" face.
   3. Edge or trim all fuzzy portions from boards and planks.

C. Veneer mill operators should:
   1. Avoid processing bolts cut from trees leaning 4 degrees or more.
   2. Clip fuzzy portions from all veneer.

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1/ Lean can be approximated (on level ground) by dropping a stone from the under side of a leaning tree at breast height and measuring the inches from point of impact to the tree bole. Each inch of distance is about 1 degree of lean.

STATION NOTE

No. 102
April 1957

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

THE BUTT LOG TELLS THE STORY

A study of 10 southern Illinois logging operations shows that the grade[1] of the best 10-foot section of the butt 16-foot log in a black oak is a good indicator of the value of the factory grade lumber contained in the whole tree.

Researchers at the Carbondale Forest Research Center diagrammed the entire merchantable length of 203 black oak (Quercus velutina Lam.) trees harvested by commercial logging crews. This consisted of identifying and plotting to scale all visible grading defects. Data resulting from a preliminary analysis of these diagrams have been used to compile a table of tree quality indexes[2] for black oak (table 1).

Table 1.--Tree quality index by tree grade, tree diameter, and merchantable height, for black oak in southern Illinois

Tree grade[1]	Merchantable height	Tree diameter (D.b.h.)										
		12	14	16	18	20	22	24	26	28	30	32
	Number of logs	Tree quality index[2]										
1	1	--	.82	.85	.88	.91	.95	.99	1.03	(1.07)	(1.11)	(1.15)
	1-1/2	--	.71	.74	.77	.81	.84	.87	.91	(.94)	(.97)	(1.01)
	2	--	.69	.72	.75	.79	.82	.85	.88	.92	.95	.98
	2-1/2 & up	--	.66	.69	.72	.76	.79	.82	.85	.89	.92	.95
2	1	.55	.58	.61	.64	.67	.70	.72	.74	(.77)	(.79)	--
	1-1/2	.53	.56	.58	.61	.63	.66	.68	.70	(.73)	(.75)	--
	2	.53	.55	.58	.60	.63	.65	.68	.70	(.72)	(.75)	--
	2-1/2 & up	(.52)	.55	.57	.59	.62	.64	.67	(.69)	(.72)	(.74)	--
3	1	.49	.51	.54	.56	.58	.61	.63	(.65)	--	--	--
	1-1/2	.48	.51	.53	.55	.58	.60	.62	(.65)	--	--	--
	2	(.48)	.50	.52	.55	.57	.59	(.62)	(.64)	--	--	--
	2-1/2 & up	(.47)	(.49)	(.51)	(.54)	(.56)	(.58)	(.61)	(.63)	--	--	--

1/ Grade of the best 10-foot section in the butt log of the tree, using the hardwood log grades described in Forest Products Laboratory Report D1737.

2/ Tree quality index values are based upon the assumption that the tree will be bucked to give full recovery of all the high-quality log material it contains. Interpolated values are in parentheses.

1/ U. S. Forest Service. Hardwood log grades for standard lumber; proposals and results. Forest Prod. Lab. Rpt. D1737. 15 pp., illus. 1949.

2/ As used in this report, tree quality index is the summation of the quality indexes of the included logs, each weighted by its respective gross volume, divided by the gross volume of the tree. Therefore, tree quality index multiplied by the price of No. 1C lumber equals the value per thousand board-feet of the lumber in that tree.

The indexes developed were field tested recently at the Kaskaskia Experimental Forest in predicting the value of factory grade lumber obtainable from 76 standing black oaks. After determining the diameter, merchantable height, and grade of these trees, each was felled and bucked. In bucking, an attempt was made to produce as much volume as possible in grade 1 and 2 logs without seriously reducing crew production. Following bucking, the logs from each tree were scaled and graded, and Forest Products Laboratory average lumber grade recovery data were used to compute "actual" tree quality indexes. These "actual" indexes were then compared to predicted indexes taken from table 1.

Discounting errors in estimating net board-foot volumes of the standing trees, average predicted and average "actual" quality indexes differed by less than 4 percent. By applying the predicted indexes to the current price of No. 1 Common, 4/4-inch, plain sawn, red oak lumber[3] the total value of the 76 trees (16,060 board-feet, International 1/4-inch rule), in terms of factory grade lumber value, was estimated to be $1,143.82. By using the "actual" indexes, the value was found to be $1,103.83--a difference of only $2.50 per thousand board-feet.

It appears probable that tree grading based on butt log quality can be refined to give even greater accuracy than that resulting from this initial field check. In an earlier phase of the study it was found that bucking crews seldom recover the maximum volume of high-quality log material in a stem.[4] Because the tree quality index table is based on full recovery of all log grade 1 and 2 material in the tree, any lower level of recovery results in product values below those predicted. Thus, at least a part of the difference found between predicted and "actual" value during this field check probably was due to the failure of the bucking crews to recover all of the high-quality material in the 76 sample trees. If further field checking establishes that full recovery of high-quality material by commercial bucking crews is not practical, the tree quality index values will be adjusted accordingly.

The data reported here are based on the first phase of a comprehensive study of hardwood timber quality. When completed, this study will provide tree quality information on 11 principal species and species groups of the Central Hardwood Region.

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and
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3/ $110.00 per thousand board-feet, f.o.b. mill.

4/ Whitmore, Roy A., Jr. and Jackson, Willard L. Increase your profit in the woods. Cent. States Forest Expt. Sta. Tech. Paper 151, 10 pp., illus. 1956.

alb Lab

STATION NOTE

No. 101
April 1957

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

Black Locust Sprouts also Susceptible to Borer Attacks

Many black locust (Robinia pseudoacacia L.) plantations on strip-mined land deteriorate so rapidly from borer attacks (Megacyllene robiniae Forst.) that no usable products can be harvested. In an attempt to overcome this difficulty, experimental cuttings were made in 3- and 13-year-old plantations in Ohio, with the hope that the resulting sprouts would grow faster and hence be more resistant to insect attack. On both plantations some plots were clear cut and others partially cut--removing alternate trees in each row. Half the plots were cut in March and half in June.

The results of these tests indicate that the sprouts of severely infested trees offer no greater possibility of producing merchantable trees than the original stems. Although the cut trees produced many fast-growing sprouts, these sprouts were as severely damaged by the borer before they reached merchantable size as the original stems.

Clear cutting resulted in more sprouts and better survival than did partial cutting. Season of cutting had little influence on sprout incidence in the clear-cut plots. Sprout survival in the partially cut plots was, however, somewhat higher in plots cut in the dormant season than in plots cut in summer. There were more sprouts per stump in the younger plantations than the older (table 1).

These two 10-year-old black locust plantations show the difference between a stand that is borer infested and one that is not. Sprout development in the stand on the left will be equally as bad.

Table 1.--Sprout development in two black locust plantations 4 years after treatment

PERCENTAGE OF BLACK LOCUST STUMPS WITH ONE OR MORE SPROUTS

Intensity of cutting	3-Year-old plantation cut during... Dormant season	Growing season	13-Year-old plantation cut during... Dormant season	Growing season
Clear cut	41	48	57	57
Partially cut	25	2	15	8
AVERAGE NUMBER SPROUTS PER STUMP				
Clear cut	2.7	2.7	2.6	2.2
Partially cut	.5	(1/)	.3	.2

1/ Less than 0.1 percent.

Table 2.--Diameters and heights of residual trees and sprouts in black locust plantations 4 years after treatment

PLANTATION 3 YEARS OLD WHEN TREATED

Treatment	Residual trees D.b.h.	Residual trees Height	Sprouts D.b.h.	Sprouts Height
	Inches	Feet	Inches	Feet
Clear cut	-	-	1.8	18
Partially cut	2.6	23	1.3	16
No cutting	2.4	23	-	-
PLANTATION 13 YEARS OLD WHEN TREATED				
Clear cut	-	-	2.0	19
Partially cut	1/4.3	1/29	1.8	18
No cutting	1/4.1	1/29	-	-

1/ The original tops of some of the trees in these stands were dead before treatment 13 years after planting; some of the trees measured on the plots as residuals are actually of sprout origin and variable age. The means here given should not, therefore, be accepted as those attained by original black locust stems in 17 years.

Height and diameter growth of sprouts did not appear to be influenced much by season or intensity of cutting (table 2). Height growth of sprouts on both sites was remarkably similar, and much greater than that of the residual trees and the original trees in the control plots. However, because of the severe borer damage, the increased growth rate is of no practical importance on these sites. On the other hand, it can be inferred that in stands not susceptible to severe borer injury, sprouts may reach merchantable size at a faster rate than original stems.

The high mortality of sprouts in the partially cut plots suggests a good method for converting black locust stands to other species. By opening up the crown canopy enough, underplanted trees can become well established without serious overtopping. Two to five years after underplanting, the residual black locust stems may be almost completely destroyed by the borer or may be cut for fence posts or mine props.

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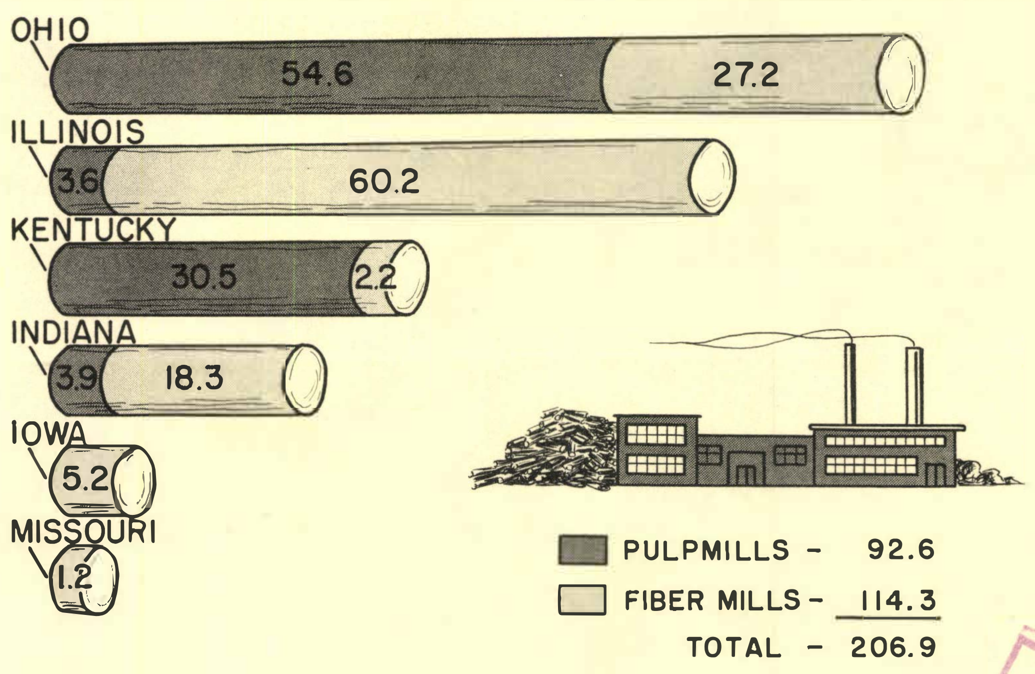
STATION NOTE
No. 100
March 1957

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

1955 PULPWOOD PRODUCTION in the CENTRAL STATES

In 1955, about 207,000 standard cords of pulpwood were produced in the Central States according to a recent 100-percent canvass of pulpmills and fiber mills.[1] (There were 4 pulpmills and 12 fiber mills in the region in 1955.) Production and use of the wood varied by states as follows:

1955 Production - Thousand Cords



(Standard Cords: 128 cubic feet - 4' x 4' x 8' unit of piled, unpeeled, round wood)

1/ Fiber mills convert wood to roofing and ceiling materials, insulation board, etc.

About 14,500 cords of this total volume were shipped to mills located in Pennsylvania, Tennessee, and Maryland. On the other hand, about 4,300 cords were produced in Wisconsin and Nebraska and shipped in to mills in the Central States.

Data obtained from the canvass could not be broken down by species or even species groups. However, there were some indications that the bulk of the material used in these pulpmills and fiber mills came from what are commonly called soft hardwoods, such as basswood, aspen, cottonwood, willow, and soft maple. Much of the remainder came from hard hardwoods such as oak, hard maple, and beech. Relatively little pulpwood was produced from coniferous species.

The production of pulpwood in 1955, as reported in this canvass, was about twice that reported for 1952. This striking increase emphasizes the need for accurate pulpwood production statistics at frequent intervals. Much of the increase came about because some companies changed their procurement practices, others increased their use of hardwoods, and some straw-using mills converted to the use of wood. Rapid change in the use of any portion of the forest resource is of vital interest to managers of both public and private forest land because new marketing opportunities can make better forest management possible. Also, wood-using and related industries need information about changes of this kind to plan operations and development programs effectively. With new developments in the techniques of hardwood pulping, continued expansion can be expected.

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STATION NOTE

No. 99
December 1956

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

A CASE STUDY OF CULL TREES ON THE KASKASKIA EXPERIMENTAL FOREST

According to the Forest Survey, roughly 19 percent of the gross volume of sawtimber in Illinois is in cull trees that are not merchantable under present marketing standards.[1] This situation presents a challenge to the wood-using industries to find ways to use some of these culls, and a challenge to the forest owners to eliminate these trees from the forest.

Both the forest owner and the commercial user of wood need more information about cull trees. To obtain some preliminary information on culls, a case study was made on 533 acres of unmanaged upland hardwood forest on the Kaskaskia Experimental Forest. This forest is considered representative of southern Illinois upland forests. The study area included some mixed hardwood type situated on northerly slopes and in coves, and some oak-hickory type that occurred on southerly slopes and ridgetops (table 1).

Table 1.--Species composition of the study area by forest type
(In percent)

Species	Mixed hardwood type	Oak-hickory type
Hickory	23	23
Red oak group[1]	30	37
White oak	22	25
Post oak	--	7
Yellow-poplar	6	1
Black walnut	1	--
Miscellaneous[2]	18	7
Total	100	100

1/ Black, scarlet, and northern red oaks.
2/ Ash, blackgum, beech, elm, maple, sassafras, and dogwood.

All trees were divided into two size classes: poletimber (5-10 inches d.b.h.) and sawtimber (11 inches and larger d.b.h.). Trees that did not contain products as outlined in table 2 were classed as culls.

The total number of cull trees recorded on 533 acres was 13,077--20 percent of all trees 4.6 inches d.b.h. and larger. Seventy-seven percent of the cull trees were of poletimber size and 23 percent were sawtimber size. There was an average of 24 cull trees per acre. According to the local merchantability standards, roughly 15 percent of the gross sawtimber volume was in cull trees.

The species having the greatest percentage of cull trees were those in the miscellaneous group, the hickories, and post oak, in that order (table 3). The oak-hickory type had a higher percentage of sawtimber culls than the mixed hardwood type, but a lower percentage of pole-sized trees. In mixed hardwoods 26 and 13 percent of all poletimber-and sawtimber-size trees, respectively, were culls. In the oak-hickory type 19 percent of the poletimber trees and 16 percent of the sawtimber-size trees were culls.

1/ King, D. B. and Winters, R. K., 1952. Forest resources and industries of Illinois. Ill. Agr. Expt. Sta. Bul. 562, 95 pp., illus.

Table 2.--Product specifications

Product and species		Minimum length	Minimum diameter	Allowable cull
		Feet	Inches	Percent
Sawtimber-sized trees:				
Logs	Hickory & misc.	10	13	25
"	Oaks	10	11	25
"	Yellow-poplar	8	10	25
"	Black walnut, black cherry	8	10	50
Ties	Oaks	8	11	0
Pole-sized trees:				
Mine props	All species	12	4	0
Mine bars	Hickory, oaks, beech, maple	12	4	0
Handle bolts	Hickory, white ash	6 2/3 1/	8	0

1/ Two 40-inch bolts.

Table 3.--Percentage of culls by species, size class, and forest type

Species	Mixed hardwood type		Oak-hickory type	
	Poles	Sawtimber	Poles	Sawtimber
Hickory	21	19	21	24
Red oak group 1/	13	8	14	12
White oak	18	8	12	10
Post oak	--	--	16	27
Yellow-poplar	13	7	7	12
Black walnut	15	15	--	--
Miscellaneous 2/	62	34	55	45
All species	26	13 3/	19	16 3/

1/ Black, scarlet, and northern red oaks.

2/ Ash, blackgum, beech, elm, maple, sassafras, and dogwood.

3/ Because of somewhat different cull standards, the Forest Survey for the State of Illinois shows 19 percent of the sawtimber board-foot volume is cull material.

Evidence from this study substantiates the Forest Survey findings which point out that for unmanaged upland hardwood stands in Illinois a forest owner can expect approximately 1/5 of the total number of trees 4.6 inches and larger to be culls. It seems clear that culls occupy a large portion of growing space and that cull eradication is a big and important job that must be done before woodlands can reach full production.

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STATION NOTE

No. 98
December 1956

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

KILLING HARDWOODS WITH HERBICIDES in Southeastern Ohio

Three herbicides were recently tested on the Vinton Furnace Experimental Forest in southeastern Ohio to find out how much it costs to use them and how effective they are in killing hardwood trees of sawtimber size. Herbicides tested included the ester forms of 2,4,5-T and 2,4-D, and sodium arsenite impregnated tabs.

Three 2.5-acre plots similar in species composition and average tree size were used for this study. White and red oaks constituted 89 percent of the stand. Tree diameters ranged from 12 to 30 inches and averaged 15 inches. All trees 11.6 inches and larger in diameter were treated during the last week of July, 1954. All of the plots had predominately a southern aspect.

The 2,4,5-T and the 2,4-D herbicides were applied to the trees in concentrations recommended by the manufacturer. The arsenite tabs (pieces of absorbent material 1/2 to 2 inches in size impregnated with 1/2 ounce of sodium arsenite) were inserted under the bark according to directions given by the manufacturer.

Frilling consisted of cutting through the bark into the cambium of each tree with an ax 12 to 18 inches above the ground line. Care was taken to join each successive cut so that a continuous frill resulted. Sufficient herbicide was applied to saturate the frills. Girdling consisted of removing a 3-inch band of bark from around the circumference of the tree at a height of 4 to 4 1/2 feet above the ground line. The herbicide was applied to the girdled area.

The sodium arsenite tabs were inserted into pockets made under the bark with a tool similar to a bark peeling spud or bent chisel that was supplied with the tabs by the manufacturer. The tabs were spaced at 5-inch intervals around the circumference of the tree and approximately at breast height. Six tabs were used on the average tree.

Cost records were kept of all operations (table 1). They included labor at $1.25 per hour; 2,4,5-T at $3.12 per quart; 2,4-D at $1.05 per quart; sodium arsenite tabs at $3.00 per hundred; and the diesel fuel for diluting the herbicides at $0.16 per gallon.

Following treatment, the trees on each plot were examined at 2-week intervals to determine the species and size of all treated trees that had been killed. These measurements were continued throughout the 1954 and into the 1955 growing seasons, the last check dating 1 year from the time of treatment.

Table 1.--Cost of deadening treatments

Treatment combinations	Cost per-- Average tree	10 inches of diameter	Square foot of basal area
	Dollars	Dollars	Dollars
Frilling, 2,4-D[1]	$ 0.099	$ 0.068	$ 0.125
Frilling, 2,4,5-T	.111	.076	.139
Girdling, 2,4-D	.186	.127	.233
Girdling, 2,4,5-T[1]	.197	.135	.248
Sodium arsenite tabs	.213	.142	.260

1/ Not tested but costs determined from other combinations.

Table 2.--Progressive percentage kill by species[1] for 1 year after treatment with 2,4,5-T in frills and 2,4-D in girdles

Number of weeks after treatment	White oaks		Red oaks		Total	
	2,4,5-T	2,4-D	2,4,5-T	2,4-D	2,4,5-T	2,4-D
2	0.0	0.0	4.2	0.0	2.8	0.0
4	.0	.0	5.1	.0	3.4	.0
6	.0	.0	5.9	2.9	3.9	1.7
8	.0	2.6	6.7	9.6	4.5	6.3
10	2.4	2.6	7.6	12.5	5.6	8.0
44	16.7	34.2	43.7	72.1	34.3	50.9
52	21.4	68.4	64.7	93.3	48.6	71.1

1/ Species other than the oaks were not affected in these tests.

Two weeks after treatment 48 percent of the trees treated with sodium arsenite tabs clearly showed some effects of the poison. Usually the leaves on the lower branches located above and in line with the tabs became brown and died. However, only one tree treated with the tabs died during the year following treatment. The sodium arsenite tabs, besides being expensive to apply, were not effective in killing sawtimber-sized trees. It was noted when these latter trees were cut that narrow strips of stained wood extended up the bole from the points where the tabs were inserted. It is possible this staining might affect the quality of lumber recovered from these logs.

In plots treated with 2,4-D and 2,4,5-T there were differences in results between treatments and between tree species within treatments (table 2). On a plot treated with 2,4,5-T the average d.b.h. of the trees killed was 13.6 inches. On the plot treated with 2,4-D the average diameter of the trees killed was 14.8 inches. A list of the species in order of decreasing susceptibility to the herbicides is as follows: (1) the red oaks; (2) the white oaks and hickories; (3) other species including yellow-poplar, hard maple, and blackgum that were not affected.

The 2,4,5-T treatment was the only one that killed trees within the first 2-week period after treatment; no kill was noted on the plot treated with 2,4-D until the sixth week. However, on this latter plot, 71 percent of the trees were eventually killed as opposed to 49 percent in the plot treated with 2,4,5-T. None of the three treatments tested was effective in loosening the bark of the treated trees sufficiently to make it easily removable when the trees were felled 1 1/2 to 2 years after treatment.

In the limited tests reported here it appears that 2,4-D is more effective than 2,4,5-T for killing trees in the red oak group 12 inches or larger in diameter. A more effective herbicide than those tested here would be necessary to kill yellow-poplar, hickories, and white oaks that are 12 inches in d.b.h. or larger.

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STATION NOTE

No. 97
November 1956

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

PIN OAK FORM CLASS

Form class data for pin oak have been relatively scarce in the Southern Illinois-Missouri area. To alleviate the shortage, average form classes for this species have been approximated from samples taken on specific areas in this region (table 1). The information presented here may help to improve your volume estimates.

Table 1.--Pin oak form class by location and d.b.h.

Diameter at breast height	Mingo Swamp	Mississippi Bottom	Claypan
6	73	71	65
8	74	72	67
10	76	73	70
12	77	74	75
14	78	75	76
16	78	76	77
18	79	76	77
20	79	76	77
22	80	76	77

Form classes were computed as follows:

$$\text{Form class} = \frac{(\text{diameter inside bark at 17 feet})}{(\text{diameter outside bark at 4 1/2 feet})} \times 100$$

Diameters at 4 1/2 feet and 17 feet above the ground were measured with a diameter tape. The double-bark thickness at 17 feet was the sum of two thickness measurements taken at right angles to each other on the tree bole, with a Swedish bark punch. Measurements at 17 feet were facilitated by using a lightweight, 16-foot, aluminum, orchard ladder. Samples were well distributed over the diameter range of existing poletimber and sawtimber trees.

The areas sampled are described below:

The Mingo Swamp area of southeastern Missouri.--This is a flat, poorly drained bottomland site, occupied by stands of pure, fairly dense pin oak. (418 trees measured)

The Mississippi Bottom area in southwestern Illinois.--This is a flat, poorly drained bottomland site, occupied by a pure, fairly dense stand of pin oak. (118 trees measured)

The Claypan area of southern Illinois.--This is a flat, poorly drained upland site of generally poorer quality than the Mingo or Mississippi Bottom areas. Again, the stands were pure pin oak, but the pole-size trees in particular, appeared to be more open grown and more limby than on bottomland sites, as a result of poorer site qualities and more open-grown stand, the form class of poles is comparatively low in this area. (106 trees measured)

It is suggested that you use the form class of the area above which most nearly approximates the stand and site conditions of your pin oak area.

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STATION NOTE

No. 96
November 1956

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

White Pine Plantations For Timber And Seed

Because eastern white pine occurs naturally in the northern and southern parts of the Cumberland National Forest but not in the central part, a study was begun in 1939 by National Forest personnel to find out the answers to two important questions: First, can white pine be successfully introduced into this section of the forest by planting? Second, will white pines planted in strategic locations develop into mature seed trees for natural seeding of certain areas? Preliminary results of this study are reported here.

Fifteen 1/10-acre plots were planted to eastern white pine. Eight of these plots were located below cliffs, on sites that would be most likely to support white pine sawtimber. The other seven plots were located on sites above and at the edge of the cliffs. Although these latter sites were not necessarily adapted to the commercial growth of this species, if enough of the trees survived until seed-bearing age was reached, they would supply seed to large adjoining areas below the cliffs.

The plots were released from competing hardwood sprouts and saplings at the time of planting and several other times during the first 5 years after establishment.

An examination of these plots early in 1956 showed the following:

	Plots above cliffs	Plots below cliffs	All plots
Average survival -- Percent	59	74	66
Average height -- Feet	15	19	17
Average 16-year height growth -- Feet per year	.9	1.2	1.1

All plots located on northerly aspects had 4 percent better survival and produced trees 2 feet taller than plots on southerly aspects (fig. 1). Height growth was best on the lower one-third of the slope; the trees were progressively shorter going up the slope (fig. 2). Survival was best on the middle one-third of the slope and poorest on the upper one-third.

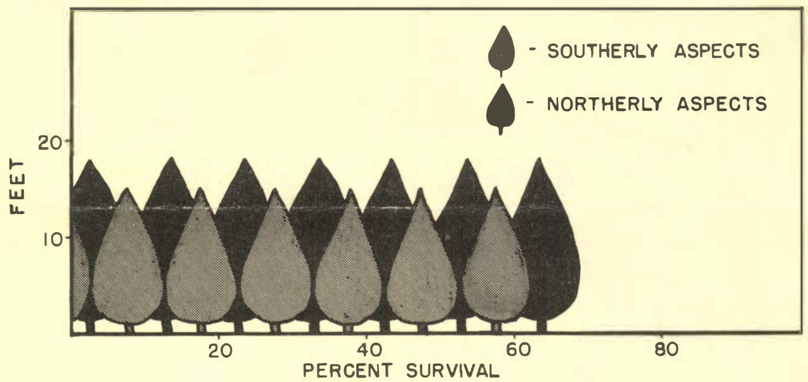

Figure 1.--Survival and height of white pine by aspect.

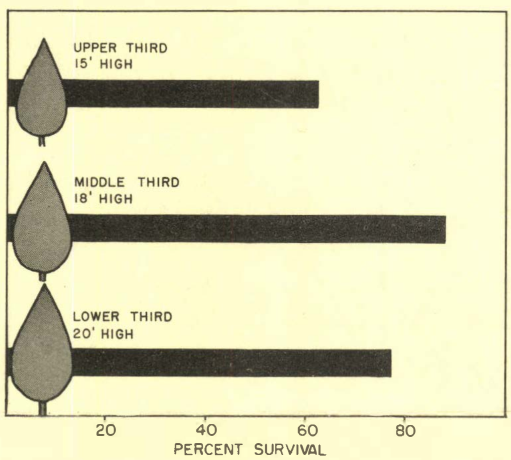

Figure 2.--Survival and height of white pine by slope position.

During the recent examination no evidence of previous seed production was found. However, five trees contained at least one cone each that would mature in 1956. It remains to be seen whether or not these cones will produce viable seeds.

These trial plantings show that white pine can be successfully planted in this locality and will make reasonably good height growth in the early years if given adequate release after initial establishment. Moreover, it seems quite likely that a white pine seed source for natural regeneration of cutover areas below the cliffs in this area can be successfully established by planting this species on high points at the top of the cliffs.

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STATION NOTE

No. 95
October 1956

CENTRAL STATES FOREST EXPERIMENT STATION
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U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

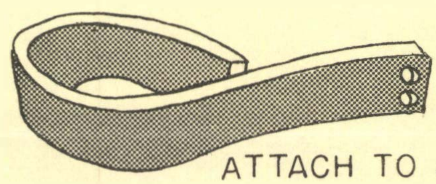
Doolittle

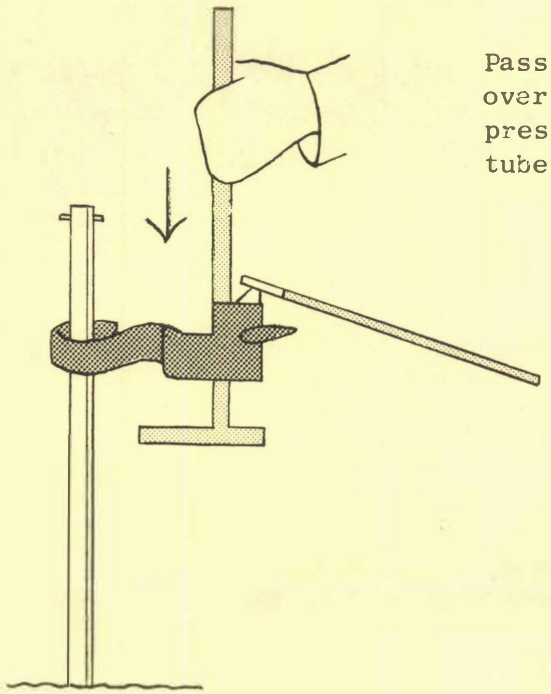
C E O

A SOIL TUBE EXTRACTOR

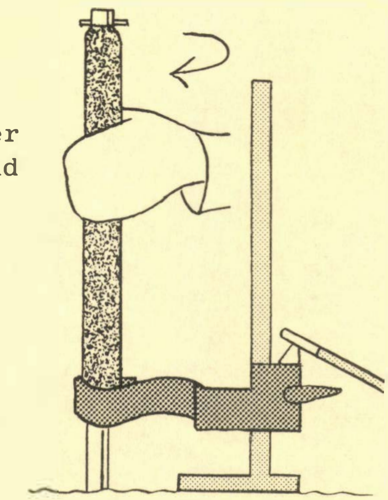
The King soil tube (used for taking soil moisture samples) is rather easily driven into even tough plastic soils but is often difficult to extract. The makers of the tube offer a jack designed especially to remove the tube but it is very heavy to carry around in the field. Personnel at the Vinton Furnace Experimental Forest have adapted a light-weight automobile bumper jack to extract the soil tube from the soil.

The jack was modified by bolting a metal extension to the bumper hook. We made this extension from a piece of scrap iron 1 1/2 x 1/4 x 13 inches by bending an oval loop in one end that is just large enough to pass over the "ears" on the top end of the soil tube. A section of 2-inch pipe that has one end slightly compressed so as to form an oval completes the equipment. The compressed end should pass over the ears on the top end of the tube. After the pipe is placed on the tube and turned one-quarter turn it will engage on the soil-tube ears. The best length for the pipe depends upon how far you usually drive the soil tube into the ground. Our pipe is 24 inches long; but you can vary this length to accommodate the minimum length of tube that you will leave extending above the ground.

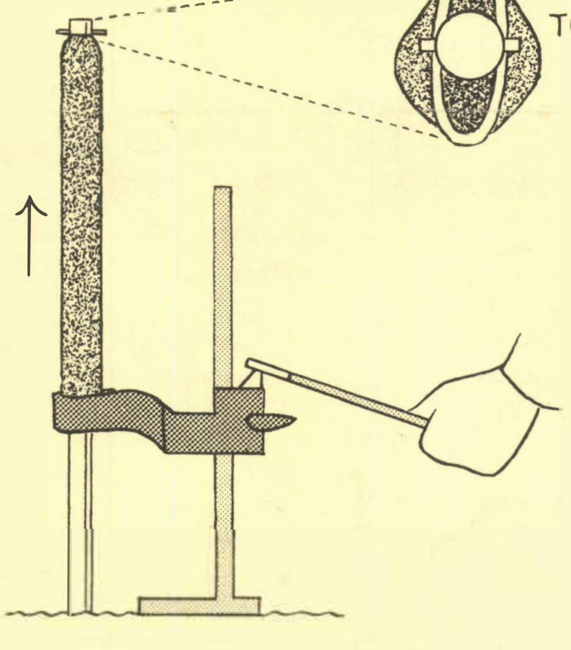


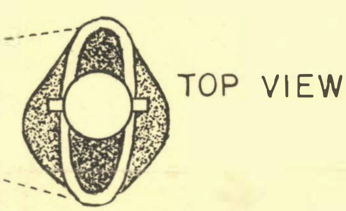


Pass the loop on the jack extension over the tube and set the fully depressed jack on its base next to the tube.



Then slip the length of pipe over the tube, with the compressed end up, and turn the tube 1/4 turn.





Finally, raise the jack and exert pressure on the pipe, which in turn starts pushing the King tube from the ground.

Russell S. Walters, research forester
Athens Forest Research Center
(Maintained in cooperation with
Ohio University) Athens, Ohio

STATION NOTE

No. 94
September 1956

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

Reprinted

GROWTH OF UNDERPLANTED HARDWOODS

IN BLACK LOCUST AND SHORTLEAF PINE PLANTATIONS[1/]

In 1947 various species of seedlings were underplanted in 8- and 9-year-old shortleaf pine and black locust plantations located in southern Illinois on land that had been strip-mined for coal. After 8 years, the trees planted under the locust are generally 2 to 3 times taller than those planted under pine. This is in spite of severe drought during the last 2 years which drastically reduced the growth rate of the trees planted under the locust but had little or no detrimental effect on those planted under the pine. When underplanted, the black locust plantation had nearly 1,200 trees per acre averaging about 22 feet in height. Most of these trees were badly riddled by locust borer. The decadent condition of the stand is similar to that of the approximately 4,000 acres of black locust plantations established on Illinois and Indiana strip-mined land up to 1940.

In the shortleaf pine plantation, winterkill in previous years had decreased stocking to less than 700 trees per acre. Heavy tip-moth infestation on the remaining trees was limiting growth severely, and the trees averaged less than 6 feet tall.

Replicated plots containing rows of 7 different underplanted hardwood species were established in the pine and locust plantations. Measurements of the underplantings were made after the second, third[2/], sixth, and eighth growing seasons (table 1). Survival of most species was good, and about the same under both cover types.

In the locust plantation, yellow-poplar and black walnut have shown the best growth by far. However, these species grew only half as fast during the drought as they did the first 6 years; during this dry period, moreover, 38 percent of the yellow-poplars have suffered dieback and sunscald. This injury is attributed to

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1/ Study conducted in cooperation with the United Electric Coal Company and the Illinois Coal Strippers Association.

2/ Results of the third-year examination were reported in Station Note 63, "Comparative Survival and Growth of Trees Planted under Three Types of Overhead Cover on Strip-Mined Land in Southern Illinois," October 1950.

the combined effects of drought and sudden exposure. Heavy thinning of the black locust overstory by continued borer attacks was apparently accelerated by the drought conditions. Yellow-poplar growing in the more open pine plantation have shown no evidence of injury, and growth has remained about the same.

Table 1.--Growth of trees planted in 1947 under poor plantations of black locust and shortleaf pine

Species[1]	Age	Black locust overstory: Average total height	Black locust overstory: Last 2 years' growth	Shortleaf pine overstory: Average total height	Shortleaf pine overstory: Last 2 years' growth
	Years	Feet	Feet	Feet	Feet
Yellow-poplar	6	14.3	5.8	4.4	2.0
	8	16.7	2.4	6.0	1.6
Black walnut	6	13.1	5.4	2.4	0.8
	8	16.0	2.8	3.9	1.6
Black walnut seed	6	12.4	5.4	2.7	1.0
	8	15.4	3.0	4.1	1.4
Silver maple	6	12.0	4.8	3.7	1.2
	8	14.8	2.8	4.3	0.6
Sweetgum	6	8.3	3.6	4.6	1.8
	8	10.5	2.2	6.6	2.0
Ash	6	4.3	1.6	3.1	1.2
	8	6.2	2.0	4.1	1.0
Osage-orange	6	6.9	2.8	2.8	0.8
	8	10.2	3.4	3.9	1.2

1/ Cottonwood was also planted under both overstories but failed completely.

Of the other species tested under the black locust and shortleaf pine overstories, sweetgum and ash appear fairly well suited for this kind of conversion planting in southern Illinois. Silver maple and osage-orange grew rapidly under the locust, but most of the trees are multiple-stemmed or excessively limby and crooked. In the pine plantation, yellow-poplar and black walnut have grown satisfactorily only on the lower slopes of the mine banks.

Glenn H. Deitschman, Forester in Charge
Ames Forest Research Center (Maintained in cooperation with the Forestry Department, Iowa State College, Ames, Iowa)

STATION NOTE

No. 93
July 1956

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

Growth of Shortleaf Pine After Thinning

Basal area growth for a 5-year period was found to be very similar in young shortleaf pine stands thinned to different densities. Stand density, as expressed by basal area, is now greater in most plots than it was before thinning. In the winter of 1950-1951 a stocking study was established in a 14-year-old plantation located on a broad ridge in southern Indiana. Four 1/10-acre plots were thinned to 80 square feet of basal area per acre, four to 100 square feet, four to 120 square feet, and four were left unthinned as checks. In each of the thinning intensities, two of the plots were thinned from above (largest trees removed) and two were thinned from below (smallest trees removed). Plots thinned to 80 square feet yielded 585 7-foot posts per acre; and those thinned to 100 and 120 square feet yielded 242 and 97 posts per acre, respectively.

The plots were remeasured after the 1953 and 1955 growing seasons. The 3-year results have been published.[1] So far, there has been no difference in basal area growth between plots thinned from above and those thinned from below.

Basal area growth, diameter growth, and mortality for the 5 years are summarized in table 1. Nearly all of the mortality occurred in the 1-, 2-, and 3-inch diameter classes. The average total height was 25 feet, 32 feet, and 36 feet for 1950, 1953, and 1955, respectively.

Table 1.--Effects of different intensities of thinning in planted shortleaf pine after 5 years

Basal area per acre (square feet)			Average d.b.h. (inches)			Number of trees per acre		
When thinned	5 Years later	Increase	When thinned	5 Years later	Increase	When thinned	5 Years later	Mortality
78.3	113.9	35.6	5.2	6.2	1.0	558	540	18
100.4	136.3	35.9	5.0	5.8	0.8	740	732	8
118.7	158.6	39.9	5.1	5.9	0.8	863	807	56
124.4 (Check)	163.1	38.7	4.9	5.6	0.7	950	895	55

1/ Limstrom, G. A. and Deitschman, Glenn H. "Early response to thinning of shortleaf pine in Indiana," Cent. States Forest Expt. Sta. Note 82, Oct. 1953. 2 pp.

The increases in basal area have been nearly equal in all densities of stocking. The greatest actual increase occurred in plots thinned to 120 square feet. The basal area growth rates by intensity of thinning are shown in figure 1. Even the check plots, which now have an average basal area of 163 square feet per acre, are still increasing rapidly in basal area. During the past two growing seasons, the growth rate has decreased very slightly. Periodic checks will be continued at 2- or 3-year intervals in order to detect any decrease in basal area growth rate. Under the conditions studied, it appears that similar plantations in this location can be left unthinned for at least 20 years without sacrificing stand basal area growth rate.

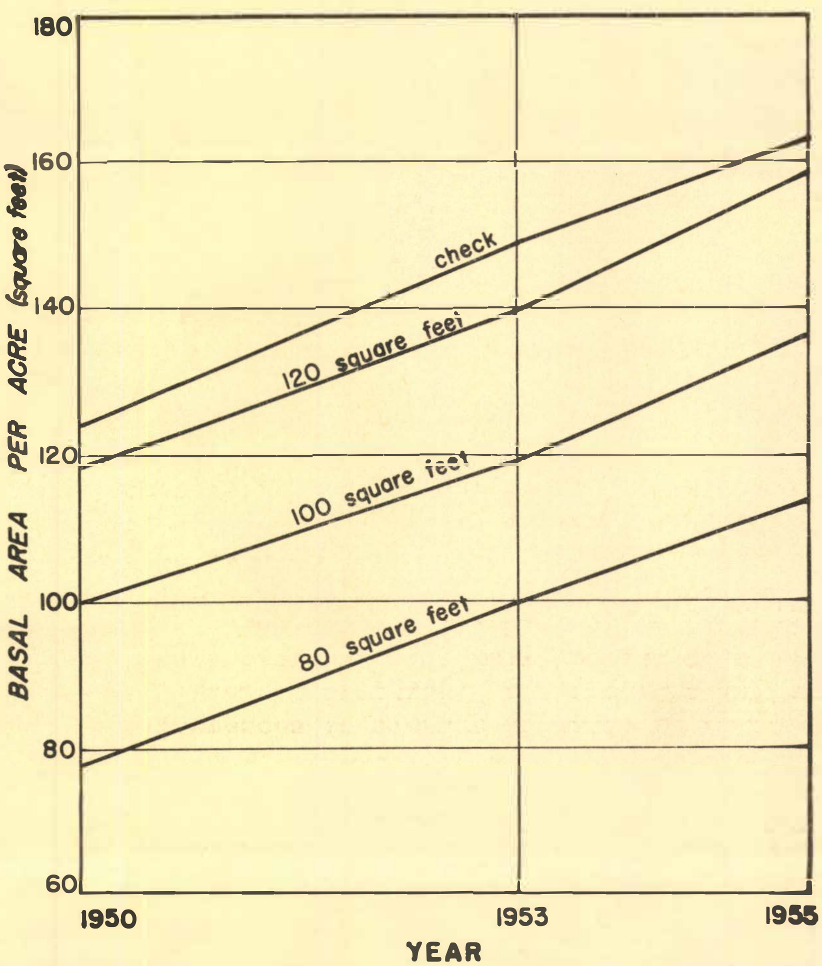

Figure 1.--Basal area by intensity of thinning and year measured.

Differences in average diameter increase were not large among plots of different stocking. The greatest difference, 0.3 inch, was between check plots and the most heavily thinned plots. Since one of the primary objectives in thinning is to increase the growth rate of the best trees and thereby shorten the rotation, the relatively small differences in diameter growth rate for stands of different densities have failed to provide clear-cut leads for recommendations at this time. Apparently heavier thinnings and thinnings at different ages will have to be tested before practical recommendations can be made as to how much and when to thin young pine stands.

F. Bryan Clark, forester
Bedford, Indiana

No. 92
April 1956

STATION NOTE

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio W. G. McGinnies, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

ELM DISEASE SPRAYS

formulas & ingredients

Research in the control of Dutch elm disease and elm phloem necrosis at the Central States Station has resulted in two spray formulas -- one for hydraulic sprayers and one for mist blowers -- that have proved to be very effective in use. The formulas are presented here, along with descriptions of their ingredients.

Ingredients	Percent by Weight	
	For Hydraulic Sprayers	For Mist Blowers
DDT	32.4	26.6
Xylol	58.6	47.5
Emulsifier	2.2	2.3
Acetone	6.8	--
White Oil	--	23.6

DDT, technical grade.--DDT has been found to be more effective in elm-disease-carrier control than chlordane, B.H.C., Heptachlor, and many of the older insecticides. Methoxychlor is as effective as DDT, but this more costly material has no apparent advantages over DDT. The DDT should have a minimum setting point of 88 degrees centigrade.

Xylol, industrial grade.--The solvent used in preparing DDT emulsifiable concentrates is the most important ingredient affecting residues and plant injury. Solvents that are too volatile (such as benzene) produce deposits that readily weather away. Solvents not volatile enough penetrate the bark instead of depositing the DDT on the surface. Solvents that dissolve only small amounts of DDT must be used in such large amounts that plant injury frequently results. For these and other reasons xylol (or xylene) was found to be the most practical solvent. Industrial grade xylol is that fraction that distills between 135 and 155 degrees centigrade. There is considerable variation between batches within this distillation range but these differences are not serious.

Emulsifier.--Tests have indicated that the anhydrous type emulsifiers are better than those containing water. There are a great many excellent emulsifiers of this type; however, Triton X-100 was proved satisfactory for the purposes of these sprays, and there appeared to be little to gain by testing others. We do believe that minimum amounts of an emulsifier should be used since quickly breaking emulsions produced longer lasting residues.

Acetone.--This material, or cyclohexanone, added to the DDT-Xylol solution will improve the holding qualities at low temperatures. DDT is likely to fall out of solution at temperatures below 50 degrees Fahrenheit in the hydraulic spray formula unless the acetone or cyclohexanone is added. Acetone does increase the fire hazard of this concentrate because of its low flash point. Cyclohexanone, when available, does not add to the fire risk.

White oil.--The only reason for adding this material to the mist blower formula is to slow down the volatility of the DDT-Xylol solution during warm weather. Without white oil, DDT crystallizes before reaching the tops of tall trees on warm days. This results in poor deposits of DDT and hence poor control. In selecting a white oil, prevention of plant injury was a prime consideration. However, any white horticultural oil having an unsulfonatable residue (UR) of 95 min., and a distillation range between 580 and 760 degrees Fahrenheit should be acceptable.

Because of the high dosages of DDT necessary to prevent elm-disease transmission by insects (much higher than normally used for other tree insects) it is important to keep the percentage of DDT high and the percentage of solvent low. The solvent is the main source of plant injury. Hence the above formulas call for higher concentrations of DDT than are usually found in standard preparations.

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Whitten, Russell R.
Protecting against Dutch elm disease. Cent. States Forest Expt. Station Misc. Release 10, March 1956.

U. S. Dept. of Agriculture
Control of Dutch elm disease and elm phloem necrosis, U.S.D.A. Leaflet No. 329, June 1952.

Russell R. Whitten, Entomologist
Central States Forest Experiment Station
Columbus, Ohio

STATION NOTE

No. 91
December 1955

CENTRAL STATES FOREST EXPERIMENT STATION
COLUMBUS, OHIO W. G. McGINNIES, DIRECTOR
U. S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

RODENTS INFLUENCE RED OAK REGENERATION

Rodents apparently have an important influence on natural regeneration of northern red oak (Quercus rubra L.) in Iowa. They may destroy most sound northern red oak acorns before germination. Acorns escaping or "missed by" the rodents during the winter may be eaten in late spring. These were the most important facts determined from a red oak direct-seeding study completed recently at the Amana Experimental Forest in east-central Iowa.

In late fall of 1954, northern red oak acorns testing 96 percent sound were sowed in an oak stand in each of four different locations. Three methods of sowing were used in an effort to duplicate possible natural conditions: (1) Seeds were placed on top of old leaves and covered with 1954 leaf fall; (2) seeds were placed on mineral soil and covered with 1954 leaf fall; and (3) seeds were planted in the soil, about 1 inch deep, with the old leaves remaining in place. For each test 320 acorns were used. Half of the acorns were covered with hardware cloth to protect them from rodents.

By mid-May 1955 most of the acorns not covered with hardware cloth had been destroyed by rodents, probably mice. All of the unprotected acorns that were placed on top of the leaves and 99 percent of those covered with leaves were taken. Even the acorns planted in the soil were not safe; 68 percent were destroyed.

At the same time all acorns were still in place on the protected plots. The hardware cloth was then removed to see if additional rodent depredation would occur after germination had started. One month later it was found that rodents had destroyed all the acorns placed both on top of the leaves and on soil beneath the leaves. Again rodents had discovered the acorns planted in the soil and had taken an average of 75 percent of them. The degree of destruction in the "planted" plots varied from 55 to 95 percent.

The possible effects of insects were also noted in connection with this study. An unidentified insect was found attacking the germinating acorns that remained in the plots that had been protected. Rodents left 25 percent of the acorns to develop into seedlings but this was reduced to 5.6 percent probably by insects that destroyed the fleshy part of the acorn.

Despite the evidence of destruction of the seed supply by rodents, observations on other areas showed oak seedlings developing in litter-free areas from acorns apparently buried by rodents. One explanation for this is that the acorns buried in bare ground are not available to the rodents, especially mice, during the winter months when the ground is frozen, and the rodents are forced to operate in litter-covered areas that remain unfrozen. Another possibility is that the lack of protective covering prevents the mice from operating freely in the area.

The study indicates there is a possibility that the general absence of red oak seedlings in the woodlands of Iowa may be due to (1) high rodent populations associated with a heavy layer of litter, and (2) the feeding habits of mice, especially as affected by the presence of a protective cover of leaves. Further investigations, especially the relationship of litter to rodent damage, are planned.

John E. Krajicek, Research Forester
Ames Branch, CSFES, maintained in
cooperation with the Forestry Department,
Iowa State College, Ames, Iowa

STATION NOTE

No. 90
December 1955

CENTRAL STATES FOREST EXPERIMENT STATION

COLUMBUS, OHIO W. G. McGINNIES, DIRECTOR

U. S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

A GOOD NORWAY SPRUCE PLANTATION IN IOWA

A 72-year-old Norway spruce plantation at East Amana, Iowa, shows that this species is well adapted to the soils and climate of the locality. The trees, planted at an 8- by 12-foot spacing, are straight, small branched, and of very good form, as shown by the accompanying photograph.

Height and diameter growth have been remarkable. The average height of the trees in this half-acre plantation is 90 feet; average diameter is 13.8 inches at breast height. The basal area and volume, as determined on a 1/10-acre sample plot, are 249 square feet and 49,000 board-feet per acre, respectively. The Girard Form Class -- a measure of taper or form -- was determined by measuring the diameter of 12 trees at breast height and 17 feet above ground. The trees have an average form class of 84, considered to be very good for this species.

John E. Krajicek, Research Forester
Ames, Branch, CSFES, maintained in cooperation with the Forestry Department, Iowa State College, Ames, Iowa

No. 89
July 1955

STATION NOTE

CENTRAL STATES FOREST EXPERIMENT STATION
Columbus, Ohio R. D. Lane, Director
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

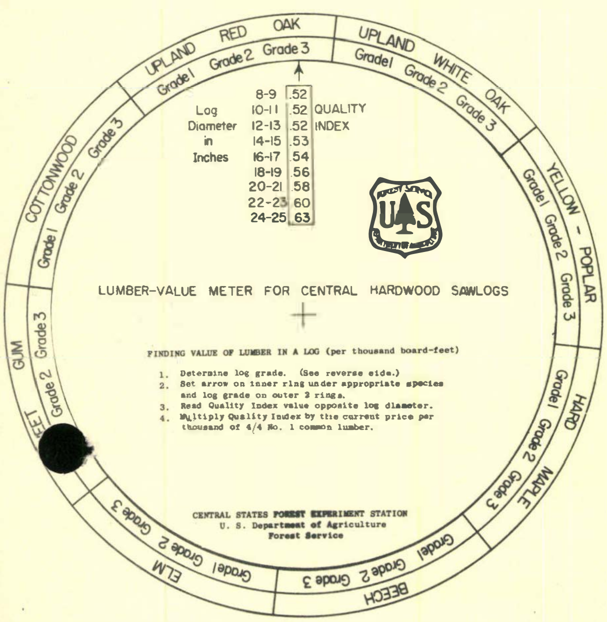
LUMBER-VALUE METER

FOR CENTRAL HARDWOOD SAWLOGS

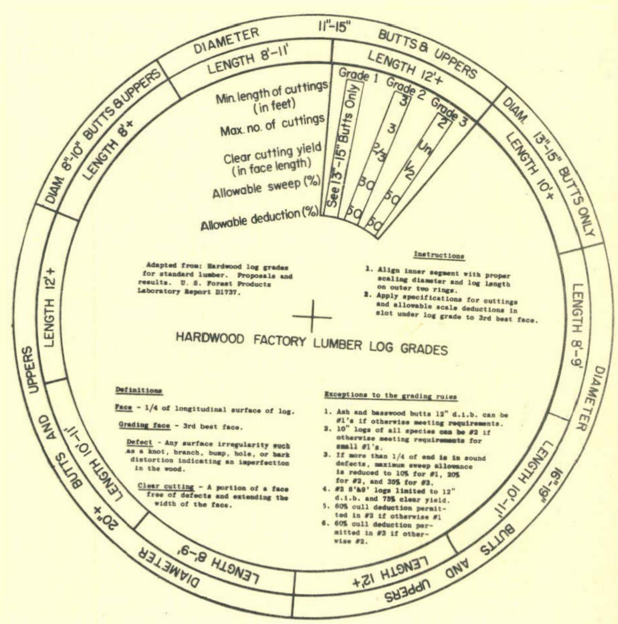
Foresters and timber operators are often required to determine accurately the value of sawlogs. This is a twofold task: First, you must determine the lumber yield of the log by grade. Then you have to convert that yield to current lumber prices. Both of these tasks can be complex and tedious, so we have tried to simplify the whole process by constructing a circular, slide-rule-type tool for use in making these calculations in the field. We call it the "Lumber Value Meter."

One side of this tool contains the Forest Products Laboratory hardwood factory log grading system, which is well known to most workers. The other side contains a summary of the less familiar "quality index" concept (2). The current price of 4/4 No. 1 common lumber can be multiplied by this index to arrive at a value per thousand board-feet for the potential lumber yield of any log.

The quality index concept is based on two principles: (1) That logs of given species, size, and grade will on the average yield the same percent of lumber in each lumber grade, and (2) that, regardless of price changes, the ratio of prices between any two grades of lumber remains about the same (1). In other words, if No. 3 common lumber sells for half what No. 1 common does, it will always sell for about half of No. 1 common, regardless of the fluctuations in price.



Two sides of Lumber Value Meter (about half size).



Information supporting the lumber-yield principle was obtained from hardwood log-grade studies made by the Forest Products Laboratory. The price ratios used here are based on the price of No. 1 common 4/4 lumber in the Tennessee Valley area for the period 1947-1951. This base was agreed upon at a conference of representatives from the hardwood-producing areas held at Purdue University in 1952.

Once the grade recovery percents and the price ratios are known, the quality index can be obtained by multiplying these two factors for each lumber grade and adding up the products. In the tool described here this has been done for you and the quality index for each of the major hardwood species of the Central States area is shown in an easy-to-use form.

How to Use the Lumber Value Meter

1. Scale the log, making necessary deductions for defect.

2. Using the log grade side of the tool, find the grade of the log.

3. Turn to the lumber value meter side of the tool. Set the pointer on the appropriate species and grade.

4. Read the quality index figure in the "window" opposite the scaling diameter of the log.

5. Multiply this figure by the current market price for 4/4 No. 1 common lumber of that species. This will give you the value per thousand board-feet of the lumber in the log.

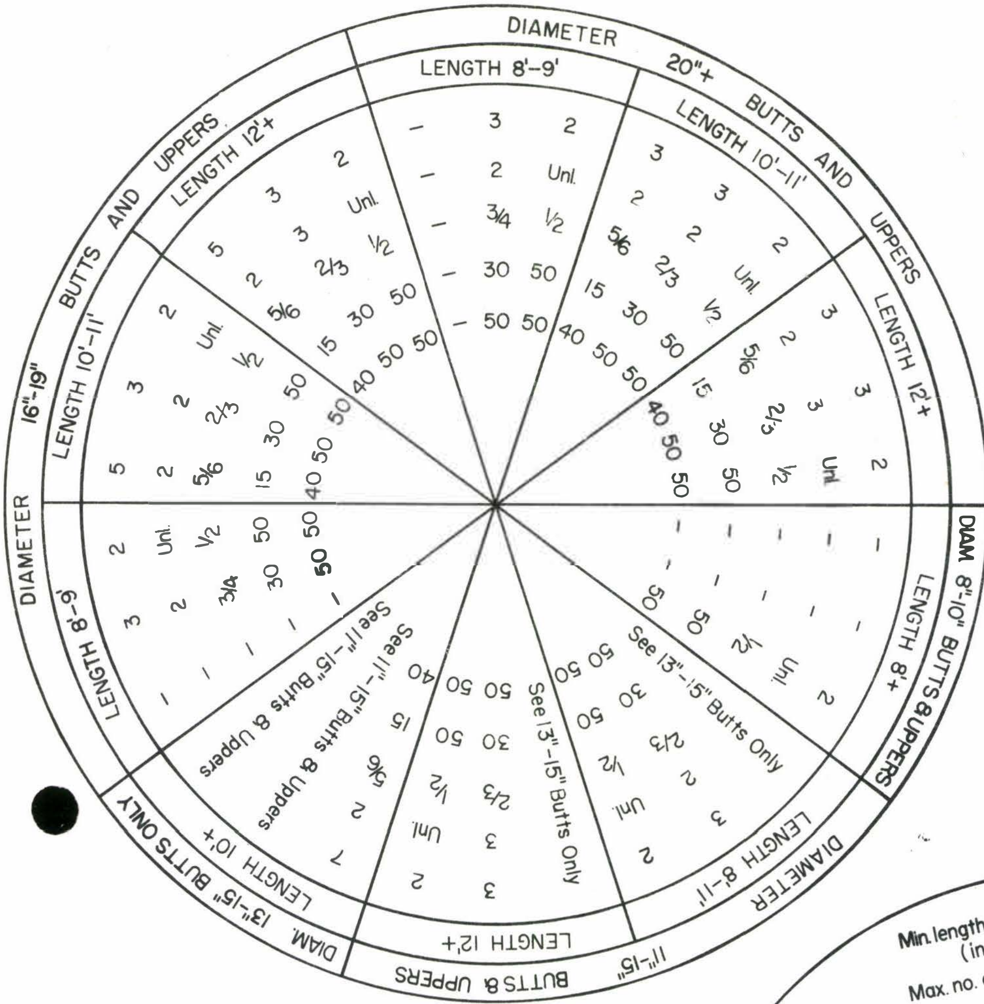
6. To find the estimated value of the lumber in the log, multiply the value per thousand board-feet by the net scale of the log and divide by 1,000.

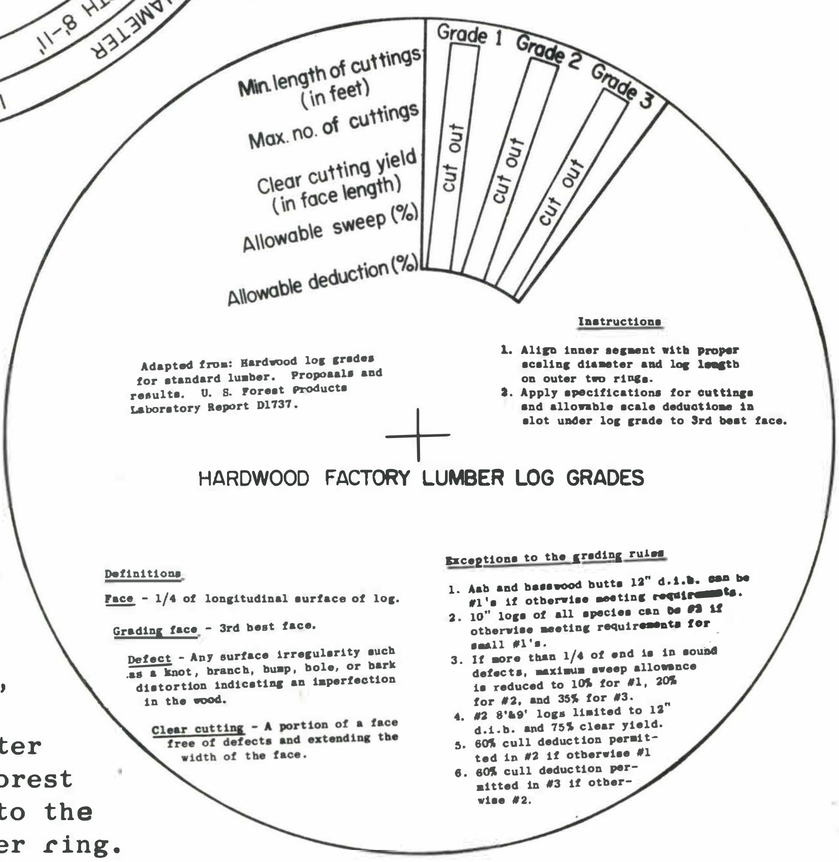
Literature Cited

(1) Ellersten, Birger W., and Lane, Paul.
1953. Lumber price ratios for computing quality index of Tennessee Valley hardwoods. Tenn. Val. Authority, Div. Forestry Relat. Tech. Note 15. 10 pp., illus.

(2) Herrick, Allyn M.
1946. Grade yields and overrun from Indiana hardwood sawlogs. Purdue Agr. Expt. Sta. Bul. 516. 60 pp., illus.

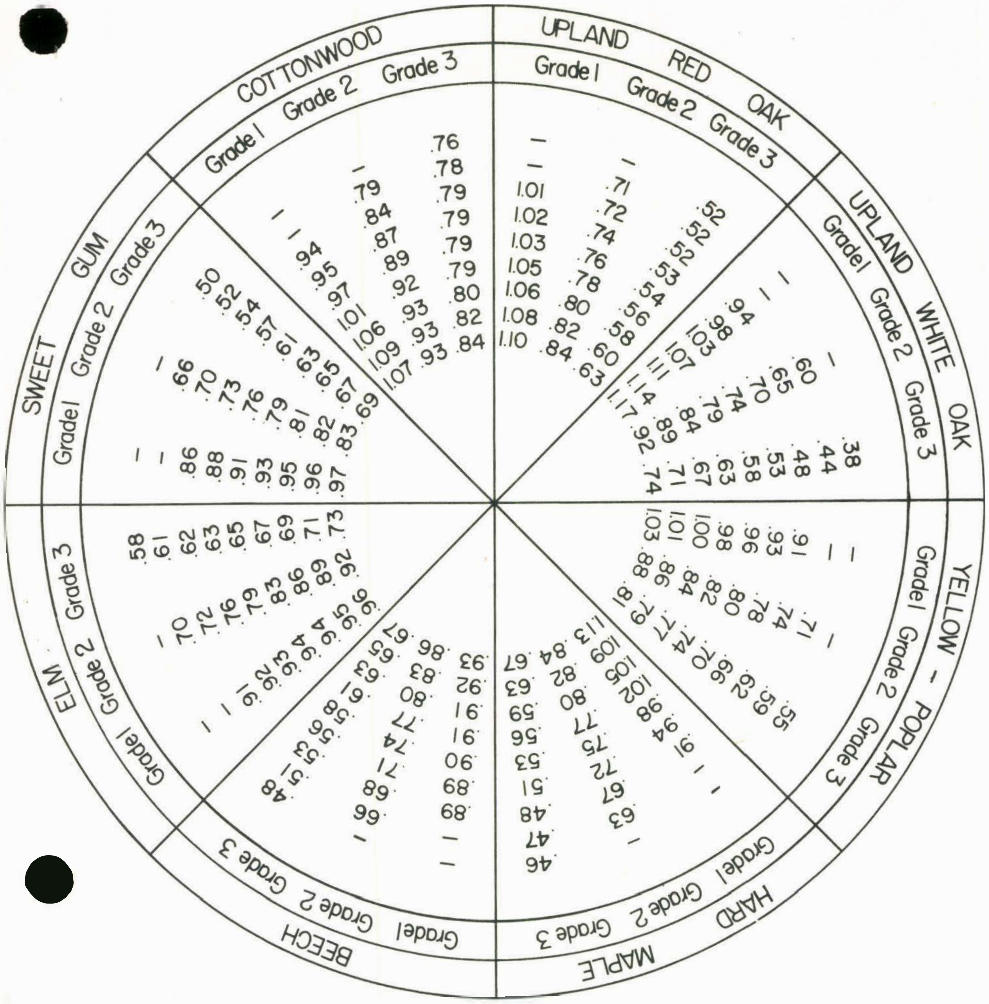
Roy A. Whitmore, forest economist
Philip L. Thornton, forester (mensuration)

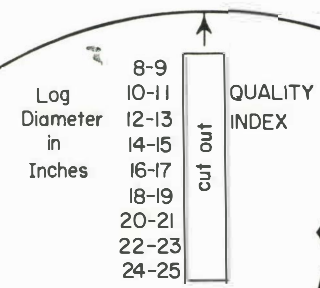




Directions for assembling

1. Cut out 4 circles.
2. Cut out "slots" in 2 smaller circles as shown.
3. Make pin-prick through center of each of the 2 larger circles.
4. Paste 2 larger circles together back to back, making sure that pin-pricks coincide exactly.
5. Using paper rivet or snap fastener, attach each smaller circle to the appropriate side of the large, center circle. Small circle containing Forest Service shield should be fastened to the side that has species names in outer ring.





LUMBER-VALUE METER FOR CENTRAL HARDWOOD SAWLOGS

FINDING VALUE OF LUMBER IN A LOG (per thousand board-feet)

1. Determine log grade. (See reverse side.)
2. Set arrow on inner ring under appropriate species and log grade on outer 2 rings.
3. Read Quality Index value opposite log diameter.
4. Multiply Quality Index by the current price per thousand of 4/4 No. 1 common lumber.

CENTRAL STATES FOREST EXPERIMENT STATION
U. S. Department of Agriculture
Forest Service

STATION NOTE

No. 88
June 1955

CENTRAL STATES FOREST EXPERIMENT STATION
COLUMBUS, OHIO W. G. McGINNIES, DIRECTOR
U. S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

2,4,5-T BETTER THAN GIRDLING FOR KILLING TREES

Oil solutions of 2,4,5-T in low, single-hack frills are more effective than waist-high notch girdles for killing unwanted hardwood trees. In a recent study in Missouri, 2,4,5-T in frills killed 75 percent of the treated trees smaller than 5 inches d.b.h., but waist-high notch girdling killed only 10 percent. Comparable kills on trees larger than 5 inches d.b.h. were 65 percent for 2,4,5-T and 41 percent for girdling. All trees were treated in March.

The main advantages of 2,4,5-T in low frills over waist-high notch girdling are: (1) higher percentage kill, especially on small trees, (2) year-round effectiveness, (3) less danger to personnel from ax injuries, and (4) little if any additional cost (limited time studies indicate that the labor saving in the 2,4,5-T treatments will about pay for the herbicide and oil).

The tree on the left was treated with 2,4,5-T in low frills. The one on the right was girdled at waist height. Note the profusion of sprouts on the girdled tree.

How to Use 2,4,5-T in Frills

1. Buy an ester form of 2,4,5-T. The ester forms of 2,4,5-T give more consistent results than do the salts or the amines.

2. Use fuel oil, diesel oil, or kerosene as a carrier. Any of the oils in this general class are satisfactory. Do not use heavier carriers such as used crankcase oil.

3. Mix 1 pound of 2,4,5-T ACID with 6 gallons of oil. Most commercial 2,4,5-T compounds contain 4 pounds of 2,4,5-T "acid" or "acid equivalent" per gallon or 1 pound per quart. Such compounds should be used at the rate of 1 quart per 6 gallons of oil. If the 2,4,5-T you buy contains only 2 pounds of 2,4,5-T acid per gallon, you will have to use 2 quarts of it for 6 gallons of oil. BE SURE YOU READ THE LABEL--THE IMPORTANT THING IS TO GET ENOUGH 2,4,5-T ACID IN THE OIL.

4. Make frills low and complete. Frills should be not more than 6 inches above the ground line--the lower the better. Ax cuts should cut through the inner bark to the sapwood, should overlap at the surface, and should encircle the stem completely. On trees with severe fire scars, galls, or other deformities, the frill should be made at the lowest point where a complete frill is possible.

5. Cut stems that are too small to frill. Stems too small to frill should be cut to leave a "V"-topped stump no taller than its diameter.

6. Apply 2,4,5-T with a sprayer. A small sprayer operated at 10 to 20 pounds pressure is a good applicator. The nozzle should deliver a very narrow fan or cone or a solid stream. The spray stream should be directed against the bark of the tree at the top of the frill.

7. Use enough solution to cover all cut surfaces thoroughly. Frills should be filled until they overflow. Stumps should be completely covered. One gallon of solution should treat about 400 diameter-inches, that is, about 100 4-inch trees or 400 1-inch trees.

8. Apply 2,4,5-T immediately after frilling or cutting. Better results are usually obtained if frills and stumps are treated promptly. The reason may be partly physiological and partly because fewer trees will be missed if they are treated promptly.

S. Clark Martin, Range Conservationist
Nelson F. Rogers, Research Forester
Columbia Forest Research Center
(Maintained in cooperation with the
University of Missouri Agricultural
Experiment Station)

STATION NOTES

CENTRAL STATES FOREST EXPERIMENT STATION

COLUMBUS 15, OHIO

FOREST SERVICE U S DEPARTMENT OF AGRICULTURE

No. 87 November 1954

SPECIAL MARKET MAKES HARVESTING LOW-GRADE TREES PROFITABLE

Removing low-grade trees from a stand of timber can often be done at a profit if the forest manager keeps close tab on local markets. This was proved recently on the Brayton Memorial Forest in Iowa in a cooperative study between the Forestry Department of the Agricultural Experiment Station, Iowa State College, and the Ames Forest Research Center of the Central States Forest Experiment Station.

As part of the study, conducted in 1952, it was necessary to remove the large cull trees left after a logging operation in order to release the reproduction. All material usable for sawlogs and veneer logs had been removed from the 20-acre area in 1944. Only defective trees and unmerchantable species were left in the stand. The stand consisted chiefly of American elm, with some red elm, silver maple, cottonwood, basswood, green ash, hackberry, northern red and white oaks, butternut, and sugar maple. This residual stand averaged 2,745 board-feet per acre (International 1/4-inch rule). Only about 25 percent of the total volume was in logs 8 feet long or longer.

During the 8-year period following the 1944 cut, good reproduction of desirable species became established over most of the area. About 90 percent of the reproduction was silver maple and green ash; the rest was cottonwood, elms, and basswood.

To remove the low-grade trees economically, a special market was needed that could process short lengths of a variety of species. An egg-case veneer-cutting plant, located about 15 miles from the forest, seemed to be a logical user for the material. Virtually all local hardwoods, except the oaks and ash, were accepted by the plant. Logs 12 or more inches in diameter, 27 inches long or in multiples thereof, free of rot and loose shake, and with knots not more than 2 inches in diameter were acceptable. Defects such as large knots and rot pockets could be left in the log provided that portion was "scaled out." This latter feature was especially advantageous since it held bucking to a minimum and reduced the number of short bolts to be handled.

The species suitable for veneer were sold to the egg-case veneer plant for $40.00 per thousand, Doyle rule. The other species, mainly ash and oak in small diameters and 8-foot logs, were sold for $25.00 per thousand, International 1/4-inch rule, to another buyer for sawing into lumber. Both prices were for logs decked at roadside in the woods. The equivalent of 54,897 board-feet of logs, International 1/4-inch rule, was removed from the area, and sold for an average of $30.93 per thousand board-feet.

When the logging was completed, it was found that a return of $28.00 per acre, or $10.22 per thousand board-feet of logs, had been made on the operation. (A breakdown of logging costs is shown in table 1.)

In the normal markets for sawlogs and veneer logs, most of the trees had no value even though they contained much sound volume in short lengths. For this reason, and because the 1944 harvest liquidated the costs of the original stand, no stumpage value is assigned to the trees cut in the 1952 harvest.

If the low-grade trees had not been harvested, it would have cost about $2.50 per acre to girdle and poison them in order to release the reproduction. So it is logical to consider that the operation resulted in a gain equal to the profit plus the savings in reproduction-release costs, or a total gain of $30.50 per acre.

Farm woodland owners with comparable stands, or stands suitable for special uses, may find it equally profitable to harvest their low-quality trees if there is a nearby market that can utilize the material. The woodland owner using comparable equipment would be earning $1.00 to $1.15 an hour for each hour he worked in his woods, in addition to the $10.22 per thousand board-feet profit.

Table 1.--Logging costs for low-grade bottom-land timber harvest

Item	Cost per hour	Hours	Cost per thousand board-feet	Total cost
	Dollars	Number	Dollars	Dollars
Labor	1.00-1.15	792	14.82	813.50
Crawler tractor and sulky	2.80	70	3.56	196.00
1-man chainsaw	.75	131	1.78	98.25
Cables, chokers, and handtools	--	--	.55	30.20
Total	--	993	20.71	1,137.95

John E. Krajicek, Research Forester
Ames Branch, CSFES, and the Forestry Department, Iowa Agricultural Experiment Station, Ames, Iowa, cooperating. Project No. 1222.

STATION NOTES
CENTRAL STATES FOREST EXPERIMENT STATION
COLUMBUS 15, OHIO

No. 86 July 1954

WOOD CHIP MULCH IMPROVES RED PINE SURVIVAL

Red pine (Pinus resinosa Ait.) seedlings mulched with wood chips showed 20 percent better survival after 2 growing seasons than similar trees that were not mulched. The mulched trees also had much better vigor. Judging by growth, color, condition, and length of needles, 81 percent of the mulched trees had "good" vigor as compared to 68 percent of the unmulched trees (fig. 1). Mulching, however, had no significant effect on average height growth.

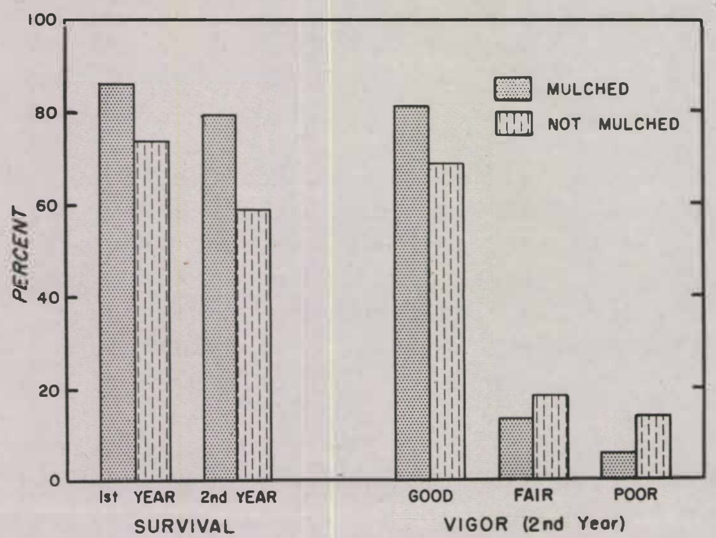


Figure 1.--Survival and vigor of mulched and unmulched red pine after 2 growing seasons. (Holst State Forest, Iowa)

This information was obtained from a study conducted cooperatively with the Forestry Club of Iowa State College on a non-cultivated, forest-type planting on the Holst State Forest, Boone County, Iowa. The plots were selected in a block of 2-2 red pine that had been machine planted on the contour in an old field by the forestry students. The ground was covered with a fairly heavy bluegrass sod and it was not plowed or otherwise prepared prior to planting. A furrow opener that turned the sod back 8 to 12 inches on each side of the trees was used on the planting machine. Eight plots were selected and the trees in four plots were mulched, leaving four plots as checks. There were approximately 50 trees in each plot. The aspect was quite uniformly south to southwest.

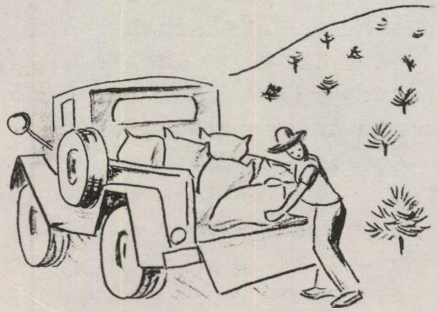
The benefits, especially during a dry period, of mulching a planting that was not cultivated were emphatically demonstrated by this test. The first growing season after planting had normal rainfall through June, but the late summer and fall were very dry. The difference in survival between mulched and unmulched trees was only 8 percent in favor of the mulched trees after the first growing season. The second year was very dry after May, and at the close of the growing season survival of the trees averaged 20 percent greater in the mulched plots. Mortality in the unmulched plots during the second year was twice that in the mulched plots.

It is doubtful that mulching would result in such a significant difference in survival if soil moisture were adequate. However, vigor may be improved by mulching even during periods of adequate moisture because the mulch keeps weeds from overtopping the trees.

The mulch, made from oak, hickory, elm, and aspen logging slash, was placed around the trees 2 weeks after they were planted. Approximately 1-3/4 cubic feet of coarse chips were measured into burlap bags, then dumped and scattered by hand around each tree in a 30- to 36-inch diameter circle to a depth of about 3 inches. No fertilizer was used in either treatment.

Soon after the trees were planted and mulched, coarse weeds and sweet clover started growing in all plots, especially in the tree rows where the sod was turned back and mineral soil was exposed. The weed growth soon became quite rank, 3 to 5 feet high, except in the mulched circles. A similar growth of weeds and clover occurred during the second growing season after the trees were planted. The plots were not cultivated at any time.

The greater survival and better vigor of the mulched trees are credited to reduced evaporation, less competition for soil moisture from adjacent vegetation, and less overtopping or shading of the trees by the tall weeds and sweet clover.



E. Garth Champagne, Forester in Charge
Ames Branch, CSFES, maintained in
cooperation with the Forestry Department,
Iowa State College, Ames, Iowa.

STATION NOTES
CENTRAL STATES FOREST EXPERIMENT STATION
COLUMBUS 15, OHIO

No. 85 April 1954

HOW TO MAKE STEREO SLIDES FROM AERIAL PHOTOS

Anyone who has to teach or demonstrate aerial-photo interpreting is faced with a recurring problem: How to illustrate to a group what he sees through a stereoscope. The latest solution to this problem is to project stereo slides made from aerial photos. The modern stereo projector and polarized glasses, familiar to 3-D movie fans, are available in the visual-education libraries of many universities and colleges. Botany, geology, and even medical courses sometimes include study of stereo slides, either projected or viewed individually. Using these stereo teaching aids reduces the instructor's problem to merely producing satisfactory slides from his file of aerial photos.

An easy and inexpensive method recently developed at this Station results in excellent slides from pairs of aerial photos at a cost only a little more than that for standard 2-by-2-inch slides.

Set up the selected pair of aerial photos by placing their common principal and conjugate-principal points in a straight line. Photos should be far enough apart so that the area to be included on the slide is visible on both prints. Tape prints together after alignment.

Next prepare a mask from an 8-by-10-inch sheet of heavy drawing paper or white cardboard (fig. 1). Since the openings in standard cardboard slide mounts are 0.85 by 0.90 inches, the openings in the mask should have proportionate dimensions. You can make them any width up to 4.0 inches, depending upon the area to be covered and the reduction desired.

Distance between openings is unimportant at this stage except that the area outlined by the mask must be identical on each photo of the pair.

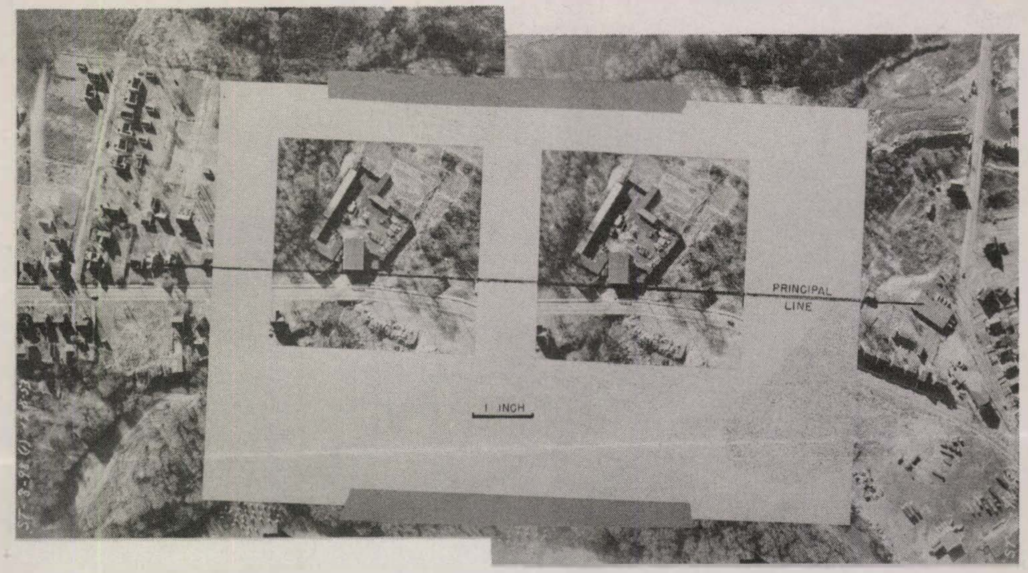


Figure 1.--Lay mask over photos parallel to the principal line of the photo pair, outlining same detail on both original prints. Openings are proportional to the 0.85-by-0.90-inch openings in the completed slide.

Orient the completed mask parallel to the principal line of the photos, showing identical detail as far as possible. Copying is done with a 35-millimeter camera. If you are not equipped to do this work, it can be done by any commercial photographer. Set the camera up at the distance necessary to reduce the opening in the mask to the 0.85-inch width of the patented stereo mount. Copy each window in the mask separately and prepare positive transparencies on 35-millimeter film. Trim the transparencies and slip into standard cardboard mounts. Then check them in a stereo-viewer. When they are properly oriented, mount the entire slide in glass for use.

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STATION NOTES
CENTRAL STATES FOREST EXPERIMENT STATION
COLUMBUS 15, OHIO

No. 84 April 1954

AN AID FOR STEREO DOT COUNTING ON AERIAL PHOTOS

Counting dots stereoscopically is one of the best ways to determine forest area from aerial photographs. To do this efficiently the interpreter must be able to accurately and rapidly orient the dot template over the photo and still have unhindered stereo vision. He must also be able to maintain a continuous flow of photos under the template with a minimum of eyestrain and picture shuffling.

With these objectives in mind a simple aid (fig. 1) has recently been developed at this Station. This device consists of a flexible template, printed on film, hinged over a 1/8-inch deep, photo-size recess in a board. The left edge of the template is strengthened by fastening it to a stiff plastic strip which in turn is hinged to the left edge of the recess. Different templates may easily be interchanged. A hard linoleum floor tile on the bottom of the recess facilitates pin pricking dots selected for detailed photo or ground measurements.

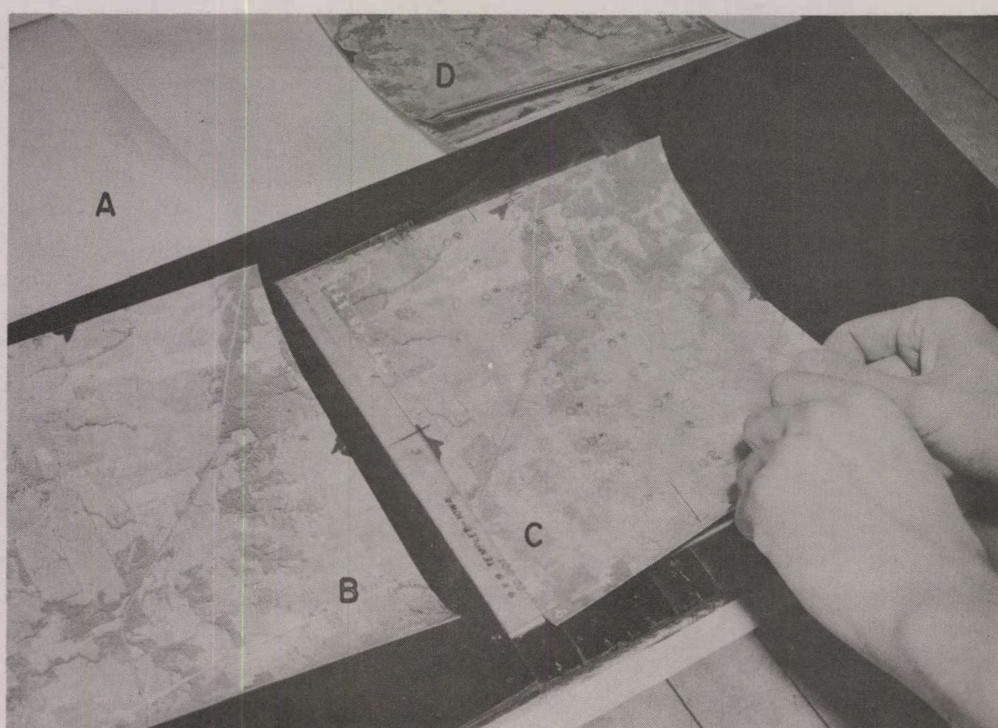

Figure 1.--The hinged dot template in use.

The board is used as follows:

1. Place photo C under the template and butt it against the top and left edges of the recess. This orients the photo properly under the dot grid on the template. The line of flight is parallel to the long axis of the board.

2. Place photo B (adjacent to C in the flight line and already dot counted) so that the portion of C under the dots can be seen stereoscopically. Using an ordinary pocket stereoscope, examine, classify, and tally the dot locations. Then pin prick and circle any dots selected for further examination.

3. Turn photo B over and place on A; use photo C in place of B and place photo D (following C in the flight line) under the template.

Dot counting is frequently done on a single photo used as a map. However, where small-scale photos must be used, or where forest and open land gradually merge, stereoscopic viewing offers distinct advantages. The three-dimensional effect and magnification obtained by using a pocket stereoscope not only add to the accuracy of forest area estimates, but also allow the use of many detailed classifications unrecognizable on a single photo.

The curves in figure 2 indicate the faster rate of stereo dot counting made possible by using this device. The rates shown are for a trained interpreter assisted by a tally man. In both methods, forest dots were classified by topographic site and samples were drawn for further examination by pin pricking and circling randomly selected dots.

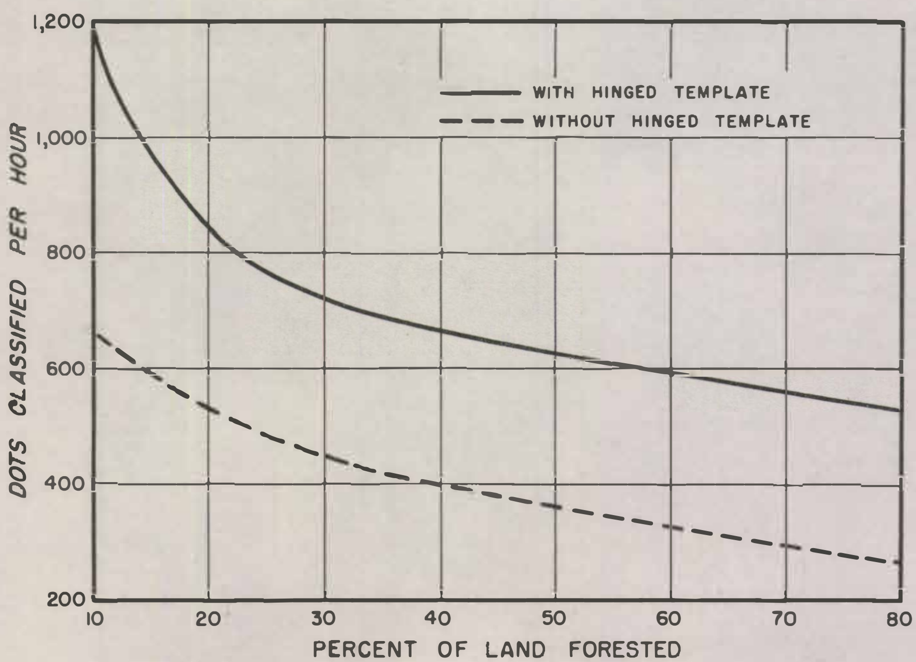

Figure 2.--Rates of stereo dot counting with and without hinged template, by percent of land forested.

Philip L. Thornton, Field Supervisor
Forest Survey

STATION NOTES
CENTRAL STATES FOREST EXPERIMENT STATION
COLUMBUS 15, OHIO

No. 83 February 1954

HARDWOOD SLASH CAN PAY ITS WAY

Hardwood slash can be removed from a logged-over area and pay the owner or operator a worthwhile hourly wage for his trouble, according to a recent study in Iowa. The study was made in cooperation with the Forestry Department, Iowa Agricultural Experiment Station, on the Brayton Memorial Forest, Delaware County, Iowa, in September 1952. Cost of converting hardwood logging slash into 16-inch fuelwood was found to be $6.48 per ton. Labor costs averaged $1.03 an hour. Thus, a farm-woodland owner could sell fuelwood at his farm for $6.50 a ton and earn more than $1.00 an hour for his time in the woods if his equipment costs were approximately the same as those in the study (table 1).

Short and cull logs and 3-inch-and-larger branches, left after a logging operation in a mixed stand of oak (northern red, northern pin, and white), were utilized. The larger pieces were bucked and split into bolts of a size that two men could handle. The bolts were skidded to a central point with a farm-type, 4-wheel tractor equipped with a rear-mounted winch. The bolts were cut on a cordwood buzz-saw mounted on the front end of the tractor.

A crew of four men was used in the study. Three men bucked and split the logging slash and the fourth man, the tractor operator, with some help from the others, did the skidding and assembling. Splitting required the most labor. In the buzzing operation, two men carried bolts to the saw-rig, the third fed the bolts into the saw, and the fourth served as off-bearer. These duties were alternated frequently to avoid fatigue. By using a short conveyor to move the cuts out of the way of the saw, the fourth man could have been eliminated and the cost of the buzzing operation reduced an estimated 20 to 25 percent. Further savings in costs, especially in the bucking operation, might have been made by being more selective in choosing the material to be sawed. Short, knotty logs are difficult to split and utilizing them increases the costs out of proportion to the volume obtained.

The costs per ton and standard cord (128 cu. ft.) for the various items of expense and different operations are shown in the following table.

Table 1.--Average cost for converting hardwood logging slash into 16-inch fuelwood (September 1952)

PER CORD

Operation	Labor[1/]		Tractor[2/]		One-man chainsaw		Hand tools[3/]	Total cost
	Hours	Dollars	Hours	Dollars	Hours	Dollars	Dollars	Dollars
Splitting & bucking	9.50	9.78	0.12	0.12	0.97	0.73	0.25	10.88
Skidding	.40	.44	.32	.32	-	-	.15	.91
Sawing	2.18	2.24	.59	.59	-	-	-	2.83
Total	12.08	12.46	1.03	1.03	0.97	0.73	0.40	14.62
PER TON								
Splitting & bucking	4.20	4.35	0.05	0.05	0.43	0.32	0.11	4.83
Skidding	.18	.19	.14	.14	-	-	.07	.40
Sawing	.97	.99	.26	.26	-	-	-	1.25
Total	5.35	5.53	0.45	0.45	0.43	0.32	0.18	6.48
Cost per hour		1.03		1.00		0.75		1.99

1/ Pay rate ranged from $1.00 to $1.15 per hour.
2/ Farm-type, 4-wheel, 25.5 dbhp, with winch and saw-rig.
3/ For axes, wedges, etc. used for splitting and bucking, and for chokers and cables used for skidding.

A total of 27.86 tons (12.38 cords) of fuelwood was produced. Two measured cords of mixed oak were weighed and the factor for converting tons to cords was found to be .4443 for the mixed oaks that were cut into fuelwood. The factor for converting cords to tons was 2.251.

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Ames Branch, CSFES, and the Forestry Department, Iowa Agricultural Experiment Station, Ames, Iowa, cooperating.

STATION NOTES
CENTRAL STATES FOREST EXPERIMENT STATION
COLUMBUS 15, OHIO

No. 81 October 1953

HOW TO GRADE YELLOW-POPLAR PLANTING STOCK

Recent experiments in the Central States region have shown that the quality of yellow-poplar seedlings used in planting operations has an important effect on field survival. Second-year results from test plantings on old fields and strip-mined lands have disclosed a significant relationship between field survival and two interacting factors: (1) Seedling size, as expressed by stem diameter, and (2) the degree of root pruning, which often varies with the method of planting used.

From analyses of 75 field plots of 25 seedlings each, it was found that the survival of seedlings less than 4/20ths of an inch in diameter at the ground line was generally less than 50 percent; that survival improved progressively from 3/20ths to 8/20ths inches when roots were pruned to maximum lengths of 10 inches. When roots were pruned to shorter lengths, however, survivals began to drop after a high in the 6/20ths-inch class. Much of the mortality of large-sized seedlings with excessively pruned roots is attributed to the disturbance of physiological processes. Top growth for this species during the first 2 years in the field depends mainly on food stored in the thickened portion of the roots, and occurs in spring and early summer when moisture conditions are usually favorable. Water absorption, on the other hand, is mainly a function of the smaller roots. So excessive root-pruning does not seriously retard top growth during the first two seasons. But if a drought occurs the roots are not sufficiently developed to supply the amount of water needed for survival.

In the same field tests the effect of top pruning was also studied. Half of the seedlings were top pruned to 5-inch lengths. (If seedlings are top pruned at the nursery, shipping costs may be reduced. Moreover, top-pruned seedlings are easier to pack in field planting trays.) The tests disclosed that top-pruning had no ill effects on field survival and initial growth.

For widespread use, stock grading specifications should be simple and easily applied. They should be so standardized that simple sampling procedures will determine if grading is actually needed. Purchasers, or men in charge of field planting operations, should know the standards required for major site types and for each method of planting. If roots must be pruned excessively to permit planting with a bar or a particular

type of planting machine, the standards must be more rigid than if other planting methods that do not require root-pruning to short lengths are used. The grading standards given in table 1 are intended to meet these requirements.

Table 1.--Planting stock grades for yellow-poplar in the Central States

Site	Stem diameter (inches)			
	Minimum		Maximum (if roots are pruned to 10 inches or less)	
	At ground line	1 inch above ground line	At ground line	1 inch above ground line
Dry, exposed	5/20 or 1/4	4/20 or 1/5	7/20 or 11/32	6/20 or 10/32
Moist, protected	4/20 or 1/5	3/20 or 5/32	8/20 or 13/32	7/20 or 11/32

Note: Discard all seedlings with broken tap-roots, scarred roots, and all seedlings with tops shorter than 1/3 the length of roots before pruning.

If 80 percent of the seedlings in a representative sample meet the desired standards, grading is neither necessary nor practicable. To reduce packing, shipping, and planting costs, the tops of seedlings may be pruned to a minimum length of 5 inches.

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STATION NOTES
CENTRAL STATES FOREST EXPERIMENT STATION
COLUMBUS 15, OHIO

No. 78 August 1953

TIME REQUIRED TO PRUNE BLACK WALNUT TREES

Time data collected in a black walnut pruning study show that pruning time increases directly with cleared height up to about 18 feet. The time required to remove the branches from a section of bole of a given length on small black walnut trees is the same whether the section is high or low on the bole.

In January 1950, a study designed primarily to determine how pruning 3- to 5-inch black walnut trees to different heights would affect growth was begun in southeastern Kansas.[1] The study trees are growing in a 2,000-acre plantation of walnut on partially graded strip-mined land. At the time of pruning, the trees were about 17 years old and the stocking averaged 500 to 600 trees per acre.

Approximately 1 out of every 4 trees was pruned. The trees averaged about 4 inches in diameter and 25 feet in height. The height to the first branch averaged 2 feet and the trees were considered limby. There was little underbrush to interfere with the work and footing was good. Pruning was done with a 3-point, 25-inch curved hand saw and an 8-point, 16-inch curved pole saw. Pruning time to the nearest minute was recorded for 90 trees--30 trees each in the 3-, 4-, and 5-inch d.b.h. classes.

Pruning time increased with d.b.h. and pruned height (fig. 1). Average pruning time ranged from about 3 minutes for 8 feet of cleared height to nearly 9 minutes for 18 feet (table 1).

The number of branches removed increased regularly with increases in cleared height (table 1). As expected, the width of the wounds decreased with increased height. Although it is harder to prune with a pole saw at the greater heights, the extra time involved was apparently offset by the smaller size of the branches being removed.

In order to estimate the total initial cost of pruning, timber managers will have to include fixed time charges as well as variable time charges such as those presented. As the pruning height is increased

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1/ This study is being made in cooperation with the American Walnut Manufacturers Association and the Kansas Forestry, Fish, and Game Commission.

STATION NOTES
CENTRAL STATES FOREST EXPERIMENT STATION
COLUMBUS 15, OHIO

No. 77 August 1953

GIRDLING TIME FOR HARDWOODS

Axe girdling of cull hardwood trees in southern Illinois was done at the rate of 6.5 square feet basal area per man-hour on uplands and 10.9 square feet per man-hour on bottom lands. The upland records were obtained over a 5-year period from stand-improvement work done on 373 acres of the Kaskaskia Experimental Forest. The bottom-land records were obtained while girdling cull trees on a 33-acre tract on the Shawnee National Forest. On both areas all cull trees larger than 4.5 inches d.b.h. were girdled. The upland species were mostly oak and hickory. Those on the bottom-land tract were chiefly silver maple, boxelder, and elm.

The data collected on 21 compartments (table 1) make it possible to estimate girdling time required if the total basal area or sum of diameters of cull trees can be determined or estimated. Yocom[1] developed a formula based on a hardwood girdling study in Alabama and checked on stands in Arkansas. He found that girdling time in man-hours could be approximated by multiplying the sum of diameters in inches by .005. When applied to the bottom-land tract in the present study, this formula gave a calculated value of 4.77 man-hours--almost exactly the actual time spent per acre. If this small test is representative, Yocom's formula can be used to estimate time required for girdling on bottom-land hardwoods in southern Illinois.

However, Yocom's formula did not fit the data for the typically rough upland topography of southern Illinois. The formula developed from the present data is as follows:

Man-hours = .00816 times the sum of diameters in inches.

The above factor of course represents an average. Actually there was some variation in girdling time because of changes in personnel, average distance between girdled trees, topography, and underbrush. There was also some indication that the mixed hardwood type required somewhat less girdling time per acre than the oak-hickory type, but this could not be statistically established from the present data.

1/ Herbert A. Yocom. Estimating the time needed for girdling hardwoods. Jour. Forestry 50:484. 1952.

For practical purposes the following conversion factors can be used to estimate girdling time for upland hardwoods in southern Illinois and similar adjacent regions:

Man-hours = .008 times sum of diameters in inches, or

Man-hours = .155 times basal area in square feet.

These conversion factors will probably tend to underestimate if many of the girdled trees are very large.

Table 1.--Trees girdled and time required for upland hardwoods on the Kaskaskia Experimental Forest

Compartment	Trees girdled per acre: Pole-size[1/]	Sawtimber-size[2/]	Basal area	Sum of diameters	Girdling time per 100 inches of tree diameters
	Number	Number	Square feet	Inches	Man-hours
1	31	8	18	333	1.11
2	29	13	25	404	.96
3	38	12	25	435	.74
4	27	5	12	248	1.11
5	28	6	14	267	.89
6	32	3	11	245	1.03
7	44	5	17	357	.70
8	21	5	12	224	.99
9	50	5	17	392	.71
10	26	6	15	263	.87
11	40	4	15	325	.57
12	25	6	14	259	.67
13	42	4	16	335	.71
14	32	7	19	325	.74
15	30	6	16	299	.63
16	19	3	9	170	.66
17	18	4	10	180	.99
18	30	4	12	260	.52
19	20	1	5	130	1.06
20	23	4	10	205	.60
21	49	3	16	363	.33
Weighted means	30.9	5.8	15.1	292	0.80

1/ Trees 4.6 to 10.5 inches diameter breast high.
2/ Trees 10.6 inches and larger.

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Benjamin A. Roach, Research Forester
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(Maintained in cooperation with
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STATION NOTES
CENTRAL STATES FOREST EXPERIMENT STATION
COLUMBUS 15, OHIO

No. 75 July 1953

GROWTH OF A WELL-STOCKED COTTONWOOD STAND[1]

Most foresters agree that cottonwood (Populus deltoides Bartr.) is a fast-growing tree. But little information is available in the central hardwoods region as to how much wood a well-stocked stand can produce on a good site during a given period.

A 25-year-old stand in southern Illinois showed remarkable board-foot growth during a 4-year period. In 1949 this 1-1/2 acre farm forest had 194 cottonwood trees per acre ranging in diameter from 5 to 23 inches (table 1). In addition, there was an understory of 38 sweetgum trees (Liquidambar styraciflua L.) 5 to 7 inches in diameter per acre.

Some striking changes took place between 1949 and 1953. There was a net loss of 56 cottonwood trees per acre. Most of the mortality occurred in the smaller, pole-size trees, as would be expected in an even-aged, sawtimber stand. The number of trees this size (5 to 10 inches in diameter) decreased from 100 to 29. The number of trees 11 to 16 inches in diameter was reduced by 6, but the number 17 inches and larger was increased by 22. This natural change in the stand structure resulted in a net basal-area growth for cottonwood of only 8.5 square feet per acre (from 138.1 to 146.6) during the period.

However, board-foot growth presented a different picture. For although mortality virtually erased basal-area growth in the cottonwood overstory, board-foot growth continued very high with a marked shift to the bigger trees. The volume of cottonwood in the stand during the 4-year period increased from 14,401 to 21,053 board-feet gross per acre, or at the rate of 1,663 board-feet per acre per year. All of the gain occurred in trees larger than 16 inches in diameter. Mean annual growth over the 29 years was 726 board-feet per acre.

If the stand is not thinned, mortality probably will become severe in the sawtimber sizes within the next 3 or 4 years and both periodic net growth and mean annual growth will be reduced. At the present rate of mortality, all of the pole-size cottonwood will disappear within that period.

1/ This study was suggested and initiated by the late Harry Switzer, Illinois State Division of Forestry.

STATION NOTES
CENTRAL STATES FOREST EXPERIMENT STATION
COLUMBUS 15, OHIO

No. 74 April 1953

AN AERIAL PHOTO SCALE-PROTRACTOR

Foresters who use aerial photos to locate field plots or to help map small areas will find a ready aid in the photo scale-protractor recently developed for the Forest Survey of the Central States Region. The aerial photo scale previously described[1] has been combined with a small protractor suitable for use on aerial photos. Using this combination the photo interpreter can (a) determine the approximate scale of his photos, (b) measure distances and angles on the photos, and (c) visualize the size of a 1/5-acre or 1-acre plot on photos of various scales.

The photo scale-protractor is printed on heavy transparent film and consists of three different scales for measuring distance and area on aerial photos (fig. 1). It may be used on photos of various scales ranging from 1:19,500 to 1:22,500 as shown. In addition the instrument has a scale graduated in inches and tenths, and a small protractor.

Scale A shows distances of a mile and fractions of a mile at the various scales. This is useful in determining the scale of photos, especially in areas where a perfect rectangular-grid survey has been made. Place the zero of line A over one section line and note the graduation nearest the next section line. If this is 20 the scale is 1:20,000. (Use the shortest distance between parallel land lines of course.) Where landmarks a full mile apart cannot be found, the 1/4- or 1/2-mile scale may be substituted. Distance between land lines should be checked against a good base map for precise work. The estimate of scale will be less accurate in mountainous areas and where surveys are irregular.

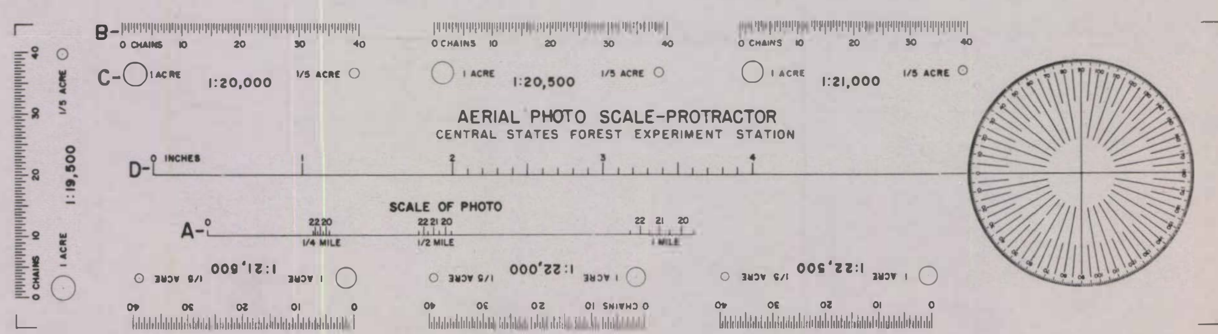

Figure 1.--The Aerial Photo Scale-Protractor.

1/ Karl E. Moessner. The Aerial Photo-Scale. Jour. Forestry 46(11):843-844, illus. November 1948.

STATION NOTES
CENTRAL STATES FOREST EXPERIMENT STATION
COLUMBUS 15, OHIO

No. 73 March 1953

GROWTH OF THINNED AND UNTHINNED LOBLOLLY PINE IN SOUTHERN ILLINOIS

In February 1949, four 1/4-acre plots were established in a 13-year-old loblolly pine plantation to study the results of thinning. The plantation was located on a good site in the claypan region of southern Illinois. After an inventory of all trees, two of the plots were thinned to 81 square feet basal area and two were left unthinned. The thinning removed most of the rougher and poorly formed dominant and co-dominant merchantable trees. (A merchantable tree has at least one 8-foot usable section to a 3-inch top inside bark.) The yield from the thinning was 318 8-foot mine props and 183 7-foot fence posts per acre.

The plots were re-inventoried after 4 years. The diameter of each tree was measured with a diameter tape and the merchantable height was estimated to a 3-inch top inside bark for each merchantable tree. The heights from the first inventory were adjusted to those of the second, thus allowing direct and accurate comparison of cubic volumes and growth.

The thinned plots made about the same basal area and volume growth in the 4-year period as the heavily stocked unthinned plots (table 1). This is very significant because growth on the thinned plots was on the high-quality trees left as growing stock. Growth on the unthinned plots was dispersed on a larger number of trees of lower average quality. Even more important, the trees on the thinned plots have well-developed crowns while those on the unthinned plots have shorter and much narrower crowns (table 2). The trees on the uncut plots are just reaching a critical point: Diameter growth is falling off rapidly and, judging from the crowns, mortality will be heavy in the next few years. During the last 4 years mortality on the unthinned plots was 2 square feet and on the thinned plots 1 square foot of basal area per acre per year.

It cannot be concluded from this study that 81 square feet is the optimum basal area of residual pine stands after thinning. However, it is apparent from these results that loblolly pine of this density on similar sites in southern Illinois should be thinned at 13 to 15 years of age.

STATION NOTES
CENTRAL STATES FOREST EXPERIMENT STATION
COLUMBUS 15, OHIO

No. 71 April 1952

DIRECT SEEDING TESTS ON OLD FIELDS IN SOUTHEASTERN OHIO

In recent studies made on old fields in southeastern Ohio 1/ methods of ground preparation had little effect on the success of direct seeding. Seed of four pines and four hardwoods was sown in an old field in Muskingum County. The field was divided into six blocks having different aspects; each block was subdivided into five plots. Each plot was either (1) disked, (2) plowed and disked, (3) furrowed, (4) burned over, or (5) left untreated. In all, 1200 seed spots 12 inches in diameter were established--40 on each plot; 20 of these were sown in the spring of 1950, and 20 were sown in the fall of 1950. During each season half of the seed spots were sown to hardwoods and half to pines.

The hardwoods sown were black walnut (*Juglans nigra* L.), northern red oak (*Quercus borealis* Michx.), white ash (*Fraxinus americana* L.), and yellow-poplar (*Liriodendron tulipfera* L.). At each hardwood seed spot the following quantities of seed were sown: 2 black walnut, 3 red oak, 10 white ash, and 10 yellow-poplar, a total of 25 seeds. The number selected for each species was based on the expected percentage of germination.

The four pines used were shortleaf pine (*Pinus echinata* Mill.), red pine (*P. resinosa* Ait.), white pine (*P. strobus* L.), and jack pine (*P. banksiana* Lamb.). Fifteen seeds of each species, a total of 60 seeds, were sown at each pine seed spot.

The hardwood seeds were collected from natural stands in the area. The black walnut and ash seed used in the spring was stored over winter by stratification; the yellow-poplar and red oak seed was kept in cold storage over winter. Hardwood seed used in the fall was sown soon after collection without pretreatment.

The pine seeds were obtained from sources within the natural range of the species and, using glass wool and nutrient materials, were pelleted by a commercial seed-treating company. The same lots of seed were used for both seasons.

1/ In cooperation with the Ohio Power Company.

STATION NOTES
CENTRAL STATES FOREST EXPERIMENT STATION
COLUMBUS 15, OHIO

No. 69 February 1952

NATURAL MORTALITY AND CULL IN BIGTOOTH ASPEN STANDS IN NORTHEAST IOWA

Bigtooth aspen (*Populus grandidentata*, Michx.) is found in commercial quantities throughout northeast Iowa and neighboring parts of Minnesota, Wisconsin, and Illinois. This species, known locally as "green" aspen or "popple," should not be confused with the smaller-leafed quaking aspen (*P. tremuloides*, Michx.). The latter is sometimes called "black" aspen and in the same locality is a much inferior tree for most purposes.

Bigtooth aspen generally occurs as small even-aged stands in openings created by logging, windthrow, or severe fires. While the younger stands often are composed almost entirely of aspen, the older ones have a mixed composition, made up of dominant and codominant aspen and species of greater shade tolerance. The bigtooth aspen is so intolerant of shade that it dies soon unless its crown stays in the upper canopy.

On good upland sites, bigtooth aspen makes very satisfactory growth, reaching sawlog size in 40 to 50 years. Three-log trees as large as 24 inches in diameter at breast height and of good form and quality have been found in northeast Iowa. In recent years a good market has developed for aspen for lumber and veneer and its sale value has increased.

Since bigtooth aspen grows well on red oak sites, it may be a desirable replacement for trees killed by the oak wilt disease. In any event, more information is needed about the silvical requirements of bigtooth aspen. While it generally is considered to be a short-lived tree, its silvicultural rotation age is not too well known.

In the spring of 1948 a study was started in 50- and 80-year-old unmanaged stands in northeast Iowa to learn more about the natural rotation age for the species. The study was established on the Paint Creek Unit, Yellow River State Forest, in Allamakee County. Five 1/5-acre plots were established in the 50-year-old stands and two plots were placed in the 80-year-old stand.

The plots were reinventoried at 2-year intervals, in the fall of 1949 and 1951, to determine mortality and condition of the aspen. In the spring of 1948 the 50-year-old stands averaged 172 living aspen trees

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No. 67 February 1952

COMPARATIVE SUCCESS OF CONIFERS AND HARDWOODS

PLANTED ON TWO OLD-FIELD SITES IN SOUTHERN ILLINOIS

By the end of their fifth year four coniferous species and three hardwood species, planted on two upland old-field sites, showed marked differences in height growth between species and between sites (fig. 1). Except for black walnut, survival of all species was good (table 1).

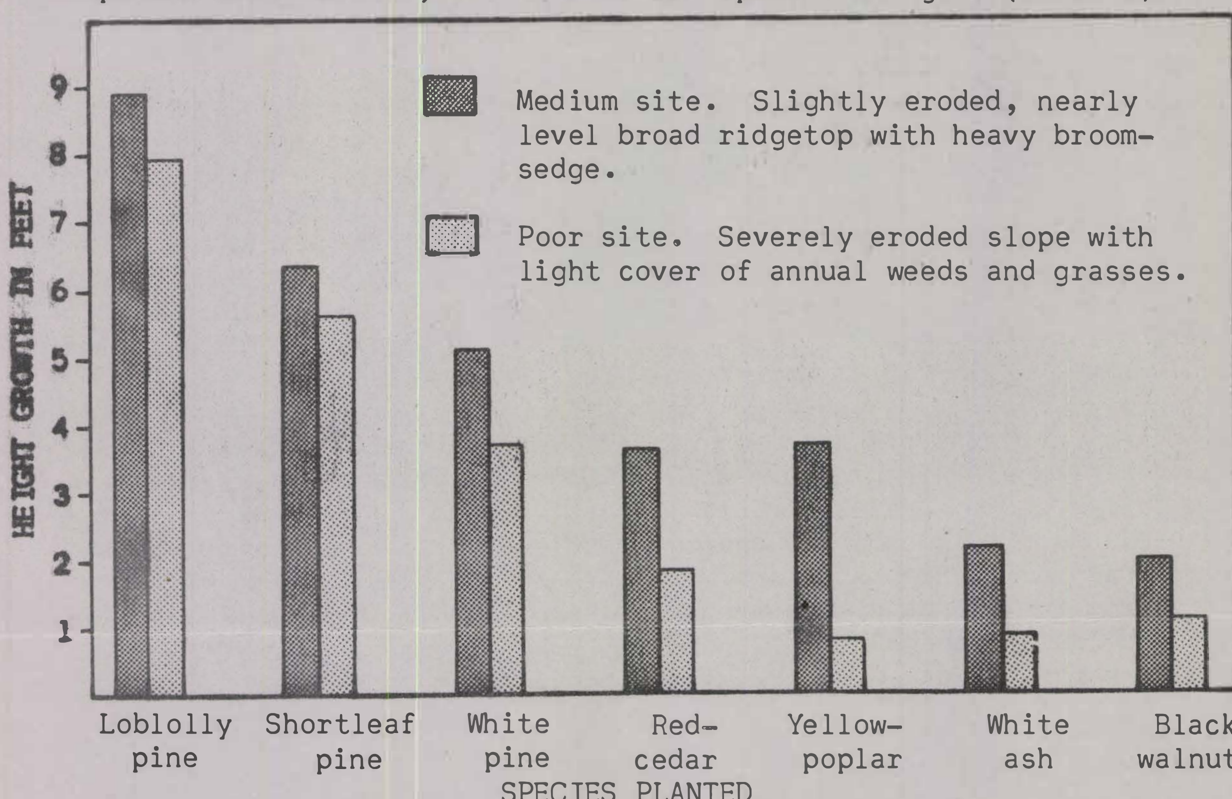

Figure 1.--Five-year height growth of seven species planted on a medium and poor old-field site.

The seven species were planted in the spring of 1947 side by side in one-sixth acre plots on each of two upland old-field areas. The medium site was a slightly eroded, nearly level, broad, low ridgetop. Only a portion of the A soil horizon had been eroded away and a heavy cover of broomsedge was present. The poor site was a severely sheet-eroded upland slope with a light cover of annual weeds and grasses. All

Barney

STATION NOTES

CENTRAL STATES FOREST EXPERIMENT STATION
COLUMBUS 15, OHIO

No. 66 December 1951

CONTROLLED SAMPLING FOR AERIAL-PHOTO TIMBER CRUISES

How many plots should you take? That's a prime question on every timber cruise! Take too many, and money is squandered on accuracy beyond that required. Take too few, and you can't depend on the results--that again, is money spent ineffectively!

What to do about it? Determine, from past experience, the miminum number of sample plots that will be needed to yield a timber volume with an acceptable error. Applying this reasoning to aerial-photo plots, we made an error analysis of 300 1-acre plot volumes as interpreted from aerial photos. Data was assembled for a range of cruise accuracies. Stand conditions involved were those of the Central Hardwood Region.

In making the error analysis, we used a basic error formula presented by Gevorkiantz and Duerr:[1/]

$$E^2 = \frac{A-Na}{AN} \times (f)$$

where

E is percent of accuracy expressed as a decimal,

A is the total area of the tract in acres,

N is the number of sample plots,

a is the area of each sample plot in acres,

f is the timber-stand factor, a constant.

1/ S. R. Gevorkiantz and W. A. Duerr. The woodlot foresters' tool kit. Ed. 2. p. 10. North Central Region U.S. Forest Service. Milwaukee. 1946.

Thus for the 750 acres in the "over 5000 bd. ft." volume class a minimum of 34 random, 1-acre plots would be needed to yield a volume accuracy of ± 5%.

The remaining 250 acres containing timber with "0-1400 bd. ft." can be cruised with much less accuracy because they will have a relatively small effect on the total volume for the tract. An accuracy of 30 percent will suffice. This volume class has an "f" value of 1.31. By substituting this value in the 30 percent formula we find:

$$N = \frac{250 \times 1.31}{(0.09 \times 250) + 1.31} = 14 \text{ plots}$$

We would therefore take 14 random, 1-acre plots in the 250 acres containing "0-1400 bd. ft."

If the same 1,000 acres were all in volume class "1500-4900 bd. ft." and the desired accuracy were 10 percent, "f" would be 0.14 and:

$$N = \frac{100 \times 1000 \times 0.14}{1000 + (100 \times 0.14)} = 14 \text{ plots.}$$

We would therefore take 14 random, 1-acre plots over the 1,000-acre area.

The formulae and table presented apply principally to hardwood timber stands in the Central Hardwoods Region, interpreted by the system described in "Timber Cruising on Aerial Photos".[3/] Remember, too, that the error relationships may vary somewhat with the ability of the photo interpreter and with the aerial volume table used.

F. Dean Brunson
Chester E. Jensen
Forest Mensurationists

3/ Karl E. Moessner and Chester E. Jensen. Timber cruising on aerial photos. Central States Forest Expt. Sta. Tech. Paper No. 126. December 1951.

STATION NOTES
CENTRAL STATES FOREST EXPERIMENT STATION
COLUMBUS 15, OHIO

No. 56 November 1949

THINNING A 13-YEAR-OLD LOBLOLLY PINE PLANTATION ON CLAYPAN SOIL IN SOUTHERN ILLINOIS

A commercial thinning of a 13-year-old loblolly pine plantation on the claypan soil common to southern Illinois yielded 3.9 cords per acre of usable products having a stumpage value of $12 to $15. These figures were obtained from a study made on a 4-acre plantation which was established in the spring of 1936 in Franklin County, Illinois. Because little planting has been done on these soils, this plantation is one of a very few that are old enough to yield commercial thinnings.

The plantation site is typical of the better-drained phases of the flat or gently rolling claypan soils. Its dense claypan is about 16 inches below the surface, but does not have the light gray color typical of the strongly leached layers on slightly lower areas that are less well drained. 1/

The original spacing of the planted trees was about 4 by 7 feet. In 1948 a complete inventory of four 1/4-acre plots showed a stocking of 1047 trees per acre having 126 square feet of basal area. At that time the heights of the dominant and codominant trees ranged from 32 to 40 feet, and the mean breast-high diameter of all live trees was 4.4 inches. On the four plots 572 merchantable trees contained 721 cubic feet of usable material. If their stems had been utilized to a 4-inch minimum top, these trees could have been converted to 9.6 standard cords of pulpwood, or to 429 mine props and 143 posts, or to 708 posts.

THINNING OF PLANTATION

The stand obviously needed thinning because of the narrow crowns, the slow diameter growth of the dominant and codominant trees, the large number of trees per acre, and the relatively large basal area. Accordingly, two of the 1/4-acre sample plots were marked for a commercial thinning that would have reduced the basal area to about 80 square feet per acre. Trees marked for removal included the rougher and more poorly formed dominants and codominants that had at least one 8-foot section with a 4-inch minimum top. The cutting removed an average of 32 percent of the total basal area and 41 percent of the number of dominant and codominant trees. The residual stand contained 81 square feet of basal area and 363 cubic feet of merchantable material per acre.

1/ For response of black locust planted on claypan soils, see Station Note No. 46, "Planted Black Locust on Claypan Soils," Central States Forest Experiment Station.